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JUNE 1965

MANUAL ON LIVESTOCK TICKS

FOR ANIMAL DISEASE ERADICATION DIVISION PERSONNEL

U.S. DEPARTMENT OF AGRICULTURE/AGRICULTURAL RESEARCH SERVICE

Prepared by

Animal Disease Eradication Division
Agricultural Research Service
United States Department of Agriculture
Hyattsville, Maryland, 20781

USE PESTICIDES SAFELY

If you use pesticides, apply them only when needed and handle them with care. Follow the directions and heed all precautions on the container label. If pesticides are handled or applied improperly, or if unused portions are disposed of improperly, they may be injurious to humans, domestic animals, desirable plants, honey bees and other pollinating insects, fish, and wildlife, and may contaminate water supplies.

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PREFACE

The Animal Disease Eradication Division and the former Bureau of Animal Industry have long been aware of the livestock tick problems in the United States. Following eradication of the cattle ticks (Boophilus spp.), however, interest in ticks diminished.

In 1960, Boophilus microplus recurred, and Rhipicephalus evertsi and Dermacentor (Anocentor) nitens were discovered, in Florida. With the resulting renewal of interest in livestock ticks, two needs became apparent: (1) More knowledge about the identity, incidence, and distribution of ticks established in the United States; and (2) wider dissemination in a usable form of the vast body of published information on ticks.

To satisfy the first need, surveys and a reporting system were started; to fulfill the second, this Manual on Livestock Ticks was prepared.

There are some 400 known species of ticks in the world. Approximately 75 of these are found in the United States; of these, perhaps 20 are of veterinary interest.

The positive identification of ticks is a prerequisite to their control and eradication. Positive identification is also essential to justify long, costly eradication programs, and the imposition of rigid quarantines.

This manual includes economic importance, descriptions, habits, life histories, as well as taxonomic keys for the identification of ticks of importance to the livestock industry of the United States.

The manual is not a definitive work in veterinary ixodiology--it is intended rather as a handy reference of condensed information for Animal Disease Eradication Division personnel concerned with the health of livestock.

A Section on Ticks, intended as the first part of a contemplated field manual on Veterinary Entomology for Division personnel, was initially prepared by W. G. Bruce, Gerald Diamant, and R. K. Strickland. The Section was issued in June 1961 and slightly revised in August 1961.

The present revision and amplification of the Section into a Manual on Livestock Ticks has been prepared by Drs. Gerald Diamant and R. K. Strickland.

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ACKNOWLEDGMENT

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MANUAL ON LIVESTOCK TICKS
For Animal Disease Eradication Division Personnel

Man, through the ages, has been beset by the many vagaries of nature and competition with plant and animal life in his struggle for survival. These plant and animal competitors include all the disease-causing micro-organisms that serve as vectors of disease and destroy man's food, feed, and fiber.

Of these numerous competitors, the ticks are among man's worst enemies. They are all parasitic, and many of them transmit diseases to man and animals. Ticks convey piroplasms and parasitic worms, viruses and bacteria, anaplasms, spirochetes, rickettsias, and paralytic toxins.

Ticks are potent transmitters of disease for a number of reasons: They have a heavy, protective, chitin covering; can withstand long periods of starvation; have a wide host range; are relatively free from natural enemies; are tenacious bloodsuckers; deposit large numbers of eggs; and are capable of regenerating lost limbs and mutilated mouthparts.

Ticks act not only as vectors, but also serve as reservoirs of certain infectious agents. Mammals are the principal hosts, but fowl and reptiles, and even amphibians are parasitized by ticks.

Despite their lack of wings, ticks have become widely distributed throughout the world. This dispersion is attributed to the movement of their many hosts. About 20 percent of the 400 known species of ticks have been found in the United States.

ECONOMIC IMPORTANCE

Cattle Fever

The most important tick parasites of cattle in the United States have been Boophilus annulatus, the cattle fever tick, and B. microplus, the tropical cattle tick. These are the principal agents in the spread of bovine piroplasmosis or cattle fever. In September 1960, the red tick, Rhipicephalus evertsi, involved in the spread of piroplasmosis and East Coast fever in Africa, and not previously known to be in the United States, was found on zoo animals in Florida and New York.

Cattle fever is produced by Babesia bigemina, a protozoan parasite of red blood cells. As the protozoan multiplies it destroys the red blood corpuscles. The host loses appetite and flesh, and finally goes into a coma and dies.

When ticks feed on an infected animal, the ingested protozoa apparently pass into the reproductive organs of the female tick and thence into the eggs. Larvae, or seed ticks, emerging from these infected eggs thus become carriers and capable of transmitting the disease organisms to

susceptible hosts. This is known as transovarian transmission, i.e., transmitting disease organisms from an infected female through the eggs to the offspring.

The ability of the cattle fever tick to withstand long periods of starvation, the potential for a single pair to produce several thousand offsprings in less than a year, and its capability of parasitizing horses, mules, deer, buffaloes, and cattle are factors that intensify its economic importance.

Anaplasmosis

Anaplasmosis was long-believed identical with piroplasmosis. It was distinguished as a separate entity in 1910, when the disease and its anaplasma bodies were found in bovines free of cattle fever.

The precise nature of the pathogenic organism that causes anaplasmosis is not known. Many scientists believe the organism is a protozoan, others theorize it is a virus, or a rickettsia, or a microorganism belonging to a group of as yet unrecognized and unclassified biological position. This microorganism, Anaplasma marginale, multiplies in the red blood cells and death may result from anemia.

While not the sole mechanisms of spread, transmission studies have incriminated 19 species of ticks in the dissemination of anaplasmosis.

Anaplasma marginale, like the causative agent of cattle fever, may be transmitted from one generation of ticks to the next. The tick vectors of primary importance in this type of transmission are the Rocky Mountain wood tick, Dermacentor venustus (= andersoni), the Pacific Coast tick, D. occidentalis, and Boophilus spp. Under favorable conditions the organism may be picked up and transferred to all succeeding stages for at least two generations--a period of 6 years--and still be capable of infecting susceptible cattle. Stage to stage transmission in the same generation has been recorded only for the winter tick, D. albipictus; the American dog tick, D. variabilis; the brown dog tick, Rhipicephalus sanguineus; and the fowl tick, Argas persicus.

Rocky Mountain Spotted Fever

This disease of man, caused by an infection of Rickettsia rickettsii, is characterized by chills, high fever, pains in muscles and joints, and eruptions of livid spots on the skin. The rickettsia may persist in the blood of an infected man or animal for months, or even years. Dermacentor venustus (= andersoni), the Rocky Mountain wood tick, is the principal vector of the more virulent form of the disease in which the mortality is 70 to 100 percent in untreated cases.

The tick, a hardy northern form resistant to severe cold, is found in the Rocky Mountain regions at elevations from 500 to 9,000 feet. This is a three-host tick and may have a life span of 2 to 6 years. Small mammals serve as hosts for the larvae and nymphs. The adult ticks require large mammals, preferably cattle and horses, to complete their development.

The causative agent of Rocky Mountain spotted fever may be transferred by ticks via the egg to successive generations.

The American dog tick, Dermacentor variabilis, is responsible for the spread of a milder form of Rocky Mountain spotted fever to all parts of the United States far beyond the range of D. venustus (= andersoni). It favors damp regions with dense underbrush. This form of spotted

fever has been particularly prevalent in the humid region of the Middle and South Atlantic States.

Tick Paralysis

Man, domestic animals, and birds in North America, Europe, South Africa, and Australia are subject to tick paralysis. While the true nature of the causal agents is not known, they act like neurotoxins, producing an ascending paralysis that leads to incoordination and collapse within 6 or 7 days. In many instances, the symptoms subside if ticks are removed from animals before paralysis has progressed too far. If the ticks are not removed, the infested man or animal dies. These toxins cannot be transferred from affected animals to healthy ones, and they seem to develop only in the female tick.

Eleven ixodid ticks and one argasid tick transmit these toxins to mammals. In poultry, only Argas persicus has thus far been recognized as a vector.

One tick alone may produce paralysis among sheep, dogs, and humans. Infestations with many ticks are required to produce paralysis in cattle, which seem more resistant.

Canine Piroplasmosis

In the United States the brown dog tick, Rhipicephalus sanguineus, is the vector of canine piroplasmosis, caused by the protozoan Babesia canis.

This tick is found throughout the world and is probably the most widely distributed of all species of ticks. It is well-adapted to the climate of the Southeastern United States. Since it can pass its entire life cycle indoors, the brown dog tick is a very annoying pest in kennels and homes.

Parasitization of the blood cells by the protozoan causes fever, inappettance, incoordination, and anemia in affected canines. If death does not result, recovered dogs may harbor the organisms in the blood for a year or more, eventually lose the infection, and become susceptible again.

Ticks as Pests

Not all ticks are vectors of disease-producing organisms, nor are all tick vectors infected with disease organisms. Ticks may, however, cause considerable injury by producing wounds susceptible to secondary bacterial infection or to attack by screwworms. Ticks also devour large quantities of blood. Severe infestations can cause anemia, loss of weight, and even death. Other losses on domestic animals, attributable to heavy infestations of ticks include those caused by "tick worry" and hide damage.

DESCRIPTION

Ticks are not insects. They are related to the scorpion and the spider in the Class Arachnida; more closely related to the mites in the Order Acarina. The order is divided into two families: The hard ticks, Ixodidae, which have a scutum; and the so-called soft ticks, Argasidae, which lack a scutum or dorsal shield (see classification chart page 11).

Adult insects are differentiated from ticks by certain well-defined characteristics. The adult insect has three body segments:

- Head with eyes and antennae.
- Thorax with six legs, two pairs of spiracles, and usually one or two pairs of wings.
- Abdomen with genitalia and eight pairs of spiracles.

Ticks are small, wingless, bloodsucking parasites that have:

- Fused head and thorax.
- Eyes, when present, small and simple.
- Mouth parts set off from the body as a false head or capitulum consisting of a characteristic hypostome armed with longitudinal rows of recurved "teeth" or denticles, highly specialized chelicerae with apical cutting digits, and palps; but no antennae or mandibles.
- Body covered with a glossy, leathery cuticle which, because of its elasticity, particularly in adult female ixodid or hard ticks, permits considerable enlargement during feeding.
- Adults and nymphs with eight legs; larvae or seed ticks with six legs.

Ticks are often referred to as being one-, two-, or three-host ticks:

- A one-host tick spends its entire developmental period, from young larva to mature adult, on one animal. Example: The cattle fever tick, Boophilus annulatus.
- The two-host ticks leave the host as mature larvae or mature nymphs, molt on the ground, and seek a second host to complete development. Example: The red tick, Rhipicephalus evertsi.
- The three-host ticks as larvae, feed on one animal and leave the host to molt; as nymphs, attach to another animal; again leave the animal to molt; and finally as adults feed on a third animal. The three animals may be of the same or different species. Example: The American dog tick, Dermacentor variabilus.

BIOLOGY

There are four stages in the life cycle of the tick: The egg, the 6-legged larva or seed tick, the 8-legged nymph, and the adult. Transition from one stage to the next is made by one or more moltings, i.e., shedding of the exoskeleton. The steps in tick development are not particularly restricted to seasons. Species adaptations, temperature, moisture, and availability of host animals influence their duration. The number of generations may vary from four or five a year in the one-host species like the cattle fever tick, Boophilus annulatus, to one a year in the Argasidae--or even one every two or more years in some three-host species, such as the Rocky Mountain wood tick, Dermacentor venustus (= andersoni).

Mating

Mating may take place on or off the host during or after engorgement. With Argasidae, for example, fertilization takes place after the adults have fed and left the host. With Ixodidae, copulation usually occurs on the host. Females appear to engorge more rapidly following fertilization.

After fertilization and engorgement the female drops from the host and crawls to a protected place to oviposit. Under favorable climatic conditions, oviposition may occur as early as the following day or, in cold weather, may be delayed for months.

Oviposition and Incubation

The gravid female readies herself for egg-laying by retracting the capitulum and extending a vesicle from between the capitulum and the scutum. The vesicle, which enlarges into two lobes, contains glands that secrete a viscid material. As the eggs are extruded from the oviduct, they are received by these extended lobes and coated with the sticky secretion. This protects the eggs from dehydration and enables them to form an adherent mass.

The numbers of eggs laid by ticks vary by species. Otobius, for example, lays batches of 150 eggs that resemble tiny bunches of golden grapes. Dermacentor occidentalis may lay 4,500. An African species, Amblyomma variegatum, reportedly deposits 20,000 eggs.

Eggs, which are initially a light yellow-brown, eventually change to a translucent brown. As incubation advances a small whitish spot, evidently embryo excreta, appears beneath the cuticle. The incubation period is determined by temperature. In the Ixodidae this may range from 16 to 202 days.

Larva

Following hatching, the larvae or seed ticks remain clustered near the place of emergence. This is a protective measure to prevent dessication and to insure survival. After a variable time interval, depending on the species of ticks, the larvae climb upon grass, small trees, or posts to await the arrival of a host. The larvae of dog ticks and rabbit ticks, which drop in or near the sleeping places of their hosts, explore those areas for a new host. Having found a host, the larvae may quickly seek out their favored site for attachment, or may wander over the host for several days before finding a suitable place to feed. Some species attach almost exclusively in the ear of the host, some prefer areas where the skin is comparatively thin, while others attach almost any place on the host.

The larvae feed, and when engorged, most species drop from the host to molt. These engorged larvae are active usually for only a few days. They then make their way to some protective covering and become quiescent. Depending upon temperature and humidity, molting to the nymphal stage may take from 5 days to several weeks or longer.

Nymph

The activities and habits of nymphs are similar to those of the larvae, except that in most species nymphs tend to live longer. In those species that molt upon the host, molting takes place following engorgement and a short quiescent period. In those species that leave the host to molt, the nymph may remain active for 1 day to 6 months before becoming quiescent. Partially engorged nymphs usually have a longer period of activity than those fully engorged. Following engorgement, the female nymph may often be distinguished from the male nymph by its greater size.

Adult

In those species that molt on the host the adult female merely crawls from the nymphal exoskeleton and reattaches at another site. The male sheds the nymphal skin, reattaches and feeds for a short time, then seeks a mate.

Adults of those species that leave the host as nymphs to molt climb upon vegetation to await a host or crawl around in search of one.

Copulation usually occurs on the host. Fertilization generally precedes female engorgement and apparently influences the rapidity of its completion. Females may engorge and drop within 20 minutes of attachment, or remain on the host for as long as 50 days. Males frequently remain upon the host much longer and thereby ensure ready mates for virgin females.

Adult ixodids engorge but once and die, following completion of oviposition. Some argasids engorge a number of times as adults and oviposit after each feeding.

Molting

Molting is essentially a part of the growth process of ticks. The hardening (chitinization) of the skin adds to its efficiency as a protective coat, but it prevents expansion of the body-wall which is necessary for the growth of the tick. Consequently, as the body grows the hard skin (cuticula) becomes too small for it. When this takes place, a second skin forms and the old skin is shed. The new skin, being extensile, accommodates the increased size of the body. In a short time as the tick grows the new skin hardens and in turn is shed or molted.

What factor or factors initiate molting is not well known. Since most ticks molt after engorgement, it is presumed that hormonal secretions stimulated by the blood meal are important factors in the molting process.

The molting pattern, however, shows considerable variation, even among closely related species of ticks. In general, hard ticks molt twice (larva to nymph and nymph to adult) and soft ticks molt two or more times before becoming adults and one or more times as adults.

FEEDING HABITS

Ticks are obligatory parasites and require blood to develop. In feeding, most ticks attach to any part of the host. Others favor the dewlap, shoulders, and the region between the legs. The tropical horse tick, Dermacentor (Anocentor) nitens, generally prefers the ear. The spinose ear tick, Otobius megnini, attaches only deep in the external ear. The red tick, Rhipicephalus evertsi, likewise feeds deep in the ear in its larval and nymphal stages and under the base of the tail or between the hind legs as an adult.

Taking a firm grasp with its forelegs and raising its abdomen, the tick drives its mouthparts through the host's skin. The rapidity of blood feeding varies considerably in different species and in different stages of the same species. The nymph of the spinose ear tick, may take 7 months to engorge. Other species, such as the adult fowl tick, engorge rapidly. Since they attach less firmly to the host these species can detach rapidly and retreat from danger.

During feeding, salivary secretions are injected into the wound. These may irritate the host for weeks or months. Also, during feeding a clear fluid (coxal fluid) is secreted from glands, which open between the first and second pairs of legs. This secretion, at least in some ticks, has been found to contain an anticoagulant. Particularly while engorging, ticks void excretory products

which may contain pathogenic organisms that can enter the animal body through the tick-bite punctures. Tick bites also predispose wounds to secondary infections and increase susceptibility to screwworm attack.

LONGEVITY

Many species of ticks are able to survive for long periods without food or water. Nymphs usually live longer than larvae. The adult fowl tick has lived without food in vacant chickenhouses for 37 months and then oviposited following a full meal. The relapsing fever tick, Ornithodoros turicata, has lived more than 3 years in jars of sand. Unfed larvae of the red tick can survive for 7 months and unfed adults for 14 months.

Moisture is an important factor in the longevity of hard ticks. Its complete absence is highly destructive. On the other hand, too much moisture, particularly following a long fasting period, permits the growth of fungi on ticks that is often fatal.

INSTINCTS AND ADAPTATIONS

Rigidly bound as they are by instinctive behavior patterns ticks, nevertheless, have made interesting adaptations for survival.

Leaving one host to molt, with the necessity of waiting for a second or even a third host, results in high tick mortality. This hazard has been overcome to some extent by developing resistance to heat and cold and the ability to withstand long periods of fasting. Amblyomma variegatum, an African species, has overcome the hazard of tick mortality and the threat to species extinction by developing the capacity to lay an enormous number of eggs--reportedly as many as 20,000.

All one-host ticks, such as Boophilus spp., the tropical horse tick, and the winter tick, have adapted themselves to molt on the host. The spinose ear tick protects itself in a different way. After its first molt on the host, it feeds as a nymph, then leaves the host, molts two more times as a nymph and as a young adult mates and oviposits without additional engorgement.

Ticks have also synchronized many of their activities with those of the host. Rabbits generally remain inactive in their nests hidden from their enemies during the day. The rabbit tick, Haemaphysalis leporispalustris, adjusted to the habits of its host by leaving the rabbit during the day. Thus, after hatching or molting, these ticks have little difficulty in finding the host when they are ready to attach. Similarly, the engorged larva of the fowl tick Argas persicus, drops only at night when its host is on the roost. When the ticks are ready to reattach, they readily find the fowl. A. persicus larvae have made another adaptation for survival. Globular in shape until a few hours before dropping, the ticks then flatten into the typical flat Argas form that permits them to crawl rapidly into protective crevices.

The adult Argas, to escape being devoured by voracious chickens, likewise has become nocturnal. During the day it hides in cracks and crevices, emerging at night to feed while fowl are inactive on the roosts.

For protection and survival the tick feeds on favorable parts of the host body. For example, the spinose ear tick, and the tropical horse tick attach deep inside the ear. Species of Haemaphysalis found on quail, field larks, and ground-feeding birds customarily attach to the head from which they are not readily dislodged.

Some ticks are able to accelerate certain stages of development. The adult cattle fever tick feeds leisurely, taking several days to become approximately one-third engorged. Then, within a couple of hours, it completes engorgement and drops from the host. The tick thus minimizes the possibility of being crushed by the host or attacked by birds or other predators. In the case of the fowl tick the larval forms remain attached to feed for several days. The adults, however, may engorge in less than an hour.

CONTROL AND ERADICATION

Natural Control

The tremendous reproductive potential of ticks is mitigated by climatological factors and by predators and parasites. In the absence of these deterrents, tick populations build up to great numbers as evidenced by seasonal or localized outbreaks.

Most important of the climatological factors are those concerned with temperature and moisture. Cold weather, particularly prolonged cold, is detrimental to some species of ticks, mainly by killing them outright, but also by prolonging their inactivity on the ground where they are more prone to attack by predators. Excessive heat, dryness, or rainfall have an adverse effect on some species.

Wild birds, domestic fowl, rats, mice, ants, and at least two species of hymenopterous (wasp-like) parasites play a part in the natural control of ticks.

Brahman cattle appear to be somewhat more resistant than other breeds to tick attack. This may be due to the odor of a skin secretion, peculiar to Brahman cattle, which acts as a repellent to ticks. In addition, the tough hide of these animals resists penetration of the tick mouthparts while the scarcity of hair provides little protection for the tick.

Pasture rotation may achieve control or eradication by starving the ticks. However, in view of the longevity of most species this type of control, without supplemental measures, is seldom practicable.

Chemical Control

The most effective method of tick control is by the use of chemical pesticides. Since the usual method of tick dispersion is by movement of the host, pesticide control can be effectively used with quarantine and regulation of animal movements. The combination of pesticides and quarantine

is essential in an eradication effort. Treatment of tick-infested premises, where extensive acreages are not involved, may also be included with other control measures.

Chemical control involves the use of pesticidal sprays, dips, dusts, aerosols, smears, or systemics. The use of systemics is a comparatively new approach to pest control. A systemic pesticide may be defined as a chemical which, when administered to an animal as a spray, dip, injection, bolus, drench, or feed additive, is absorbed into the body tissues, either in its original form or as a metabolite, and is toxic to susceptible parasites feeding on such tissues.

Most species of ticks can be effectively controlled by the proper use of pesticides. "Effectively controlled" here means the reduction of tick populations to the point where they are of little or no economic importance. It is differentiated from eradication in that the latter means the complete annihilation of a species from a defined geographical area--as was done with the cattle fever tick.

A large number of pesticides are effective against ticks. They include arsenicals, BHC, chlordane, coumaphos (Co-Ral),[1] DDT, Delnav, toxaphene, lindane, and many others. The pesticide of choice will be determined by several factors, such as species of animal--cattle, horses, and swine--the type of animal--dairy or beef--and the cost of pesticide used. Consideration must be given to compliance with the Federal Food, Drug and Cosmetic Act with reference to the presence of pesticide residues in raw agricultural products, including meat and milk. If dipping is part of an official ADE program, only those chemicals permitted by the Division may be used.

No attempt is made here to elaborate on the subject of pesticides and their uses. Instructions on vat management and the use of permitted pesticides for the control or eradication of ticks and insects of concern to the Animal Disease Eradication Division are issued by the Director as needed.

IDENTIFICATION OF TICKS

The positive identification of ticks is a prerequisite to their control and eradication. Positive identification is also essential to justify long, costly eradication programs, and the imposition of rigid quarantines.

Unfortunately there are not now, nor are there likely to be, simplified keys or procedures for the rapid creation of identificaton experts. The positive identification of the numerous species of ticks is a matter for the trained tick taxonomist. Nevertheless, there is no reason why ADE veterinarians and livestock inspectors cannot, and should not, develop familiarity with the biology and identification of the more common livestock ticks in the United States.

An explanation of all characters will be found on pages 12-16. Drawings of a hypothetical tick showing the location of key characters appear on pages 29-31.

[1] Trade names are used in this publication solely for the purpose of providing specific information. Mention of a trade name does not constitute a guarantee or warranty of the product by the Federal Government or an endorsement by the Government over other products not mentioned.

After making a tentative identification, all suspected cattle fever ticks and other exotic species should be forwarded for confirmation through the ADE Veterinarian in Charge to:

ADE Regulatory Laboratories, Technical Services,
Ectoparasite Unit
Agricultural Research Center, Building 320
ARS, USDA
Beltsville, Maryland

769-385 O-65—2

CLASSIFICATION OF TICKS OF VETERINARY INTEREST IN THE UNITED STATES

Phylum	Class	Order	Suborder	Family	Genus	Species	Common Name
Arthropoda	Arachnida-Acarina-	Insecta (insects)	Ixodides (ticks)	Ixodidae (hard ticks)	*Ixodes*	*pacificus*	California black-legged tick.
						scapularis	black-legged tick.
					Haemaphysalis	*leporispalustris*	rabbit tick.
					Boophilus	*annulatus*	cattle fever tick.
						microplus	tropical cattle tick.
					Rhipicephalus	*evertsi*	red tick.
						sanguineus	brown dog tick.
					Amblyomma	*americanum*	Lone star tick.
						cajennense	Cayenne tick.
						hebraeum	bont tick.
						imitator	none.
						maculatum	Gulf Coast tick.
					Dermacentor	*albipictus*	winter tick
						nigrolineatus	brown winter tick.
						nitens	tropical horse tick.
						occidentalis	Pacific Coast tick.
						variabilis	American dog tick.
						venustus (= andersoni)	Rocky Mountain wood tick.
				Argasidae (soft ticks)	*Argas*	*persicus*	fowl tick.
					Otobius	*megnini*	spinose ear tick.
					Ornithodoros	*coriaceus*	pajaroello tick.
						talaje	none.
						turicata	relapsing fever tick.
				Sarcoptidae and Psoroptidae (mites)			

THE KEY AND HOW TO USE IT

The key to the identification of ticks presents important characters of ticks arranged to facilitate identification. This key is for adult ticks only and primarily for ticks of veterinary interest in the United States.

It will be noted that the key is arranged in couplets, each couplet giving a choice of two alternate characters or two alternate groups of characters. Start with the first couplet and proceed to the couplet indicated by the number following the appropriate character, and so on until the final determination is made. For example, place the specimen under the microscope topside (dorsum) up; focus the microscope and adjust the light on the tick. Have the drawing of a composite tick with parts labelled (pages 29-30) and the explanation of terms (pages 12-16) handy for ready reference.

Look at the first page of the key and note that the first thing to determine is whether the specimen under the microscope is a hard tick (Ixodidae) or soft tick (Argasidae). Compare the characters in this couplet, then look at the tick, and you will find that the tick has a scutum (shield) and the capitulum (head) is at the anterior end of the body. It, therefore, is a hard tick (Ixodidae) and the reference is to page 17.

Start with couplet 1. The important character here is the anal groove--is it in front of the anus or does it curve behind the anus, or is it absent? The specimen tick has a small groove behind the anus, so proceed as indicated to couplet 2. Here the choice is between a palpus with the second segment projecting conspicuously to the side or a palpus without such projection. The tick fits into the second category, so proceed to 3. Here the choice is mainly between a hexagonal (6-sided) basis capituli or one not 6-sided. The basis capituli on the specimen is rectangular, so proceed to 5. Look at the palpi under the microscope--are they long, and is the second segment at least twice as long as it is wide, or are they short with the second segment less than twice as long as its width? You immediately see that your specimen fits the second description, therefore you identify the tick as belonging to the genus Dermacentor. Now turn to page 23. Check specimen with "General Morphological Characteristics of the Genus" under "GENUS DERMACENTOR." If they all fit you can be certain you have keyed the specimen to the correct genus. Proceed now in the same manner through the key to the species of Dermacentor and you will identify the tick as Dermacentor variabilis.

EXPLANATION OF TERMS USED IN THE KEY

Accessory shields: Paired, projecting, sclerotized structures on venter, lateral to the adanal shields in males of Boophilus and Rhipicephalus.

Adanal shields: Paired, projecting, sclerotized structures on venter, lateral to the anus in male Boophilus and Rhipicephalus.

Anal groove: Semicircular groove curving around the anus in some genera of Ixodidae (hard ticks); in Ixodes curving in front, in other genera curving behind or absent.

Anterior: Toward the head end.

Anus: Posterior opening of the alimentary tract, situated on the median line posterior to the last pair of legs.

Basis capituli: Basal portion of capitulum on which the mouth parts are attached. May be of various shapes: hexagonal, rectangular, or roughly rectangular in hard ticks, and always attached to anterior of body. In soft ticks always located ventrally in adult and engorged nymph.

Camerostome: Cavity or depression in which the capitulum of soft ticks is situated. Usually not well-defined in engorged specimens.

Capitulum: Anterior movable portion of body of hard ticks, including basis capituli, palpi, hypostome, and chelicera of hard ticks. Located ventrally in adult and engorged nymph of soft ticks.

Caudal process: Distinct, pointed projection arising from median posterior end of the body in male Boophilus microplus. (A character used to differentiate male B. microplus from male B. annulatus.)

Cervical grooves: Pair of grooves in the scutum extending posteriorly from the inner angles of the scapulae. May be continuous or interrupted, shallow or deep, faint or absent.

Cheeks: Paired flaps at the sides of the camerostome in some species of soft ticks.

Chelicera (pl. chelicerae): Paired structures lying dorsally to hypostome which complete the cylindrical mouth parts that are inserted when the tick feeds.

Chitin: Colorless secretion forming the hard parts of the tick body.

Chitinized: Filled in with or hardened by chitin.

Chitinized tubercles: Small, chitinized, rounded lobes on the postero-internal angle of the festoons of Amblyomma cajennense.

Cornua: Small projections extending from the dorsal, latero-posterior angles of the basis capituli.

Coxae (sing. coxa): Small, sclerotized plates on the venter representing the first segment of the leg to which the trochanters are movably attached. From anterior to posterior, the coxae are designated by Roman numerals I, II, III, and IV. Bifid coxae are those that are cleft, divided into two parts, or forked.

Cuticula, or cuticle: Outer covering of a tick.

Denticles: Small, recurved projections or "teeth" on the ventral side of the hypostome. (See dentition.)

Dentition: Refers to the presence of denticles on the ventral side of the hypostome. The numerical arrangement of the files or rows of denticles is expressed by the dentition formula. Thus, dentition 3/3 means that there are three longitudinal rows of denticles on each side of the median line of the hypostome.

Dimorphism: Difference in form, color, etc., between individuals of the same species, more particularly between sexes.

Distal: Farthest from the point of attachment or origin.

Dorsal: Pertaining to the back or top side of the body.

Dorsal humps: Protuberances on the dorsal surface of the segments of the legs, but not including the subapical dorsal protuberance.

Dorsum: The entire dorsal surface of the body.

Emargination: Anterior indentation or cut-out place in the scutum between the scapulae that receives the basis capituli.

Engorged: Enlargement or distention of a tick following a blood meal. Since the scutum is short in the female hard tick (covering about half the dorsal surface in the unfed specimen), the body is capable of pronounced distention. As the body fills with blood, the relative size of the scutum is reduced. In a fully engorged female hard tick, the scutum may appear only as a small plate on the anterior of the body. In the soft tick the scutum is absent and both sexes may become enlarged although not usually to the extent of the engorged female hard tick.

Festoons: Uniform rectangular areas, separated by distinct grooves, located on the posterior margin of most genera of the hard ticks. Very distinct areas in unengorged specimens, but more difficult to see in the engorged female.

Files: Longitudinal rows of denticles or "teeth" on the ventral surface of the hypostome.

Genital aperture: External opening of the genital organs. Located anteriorly on the ventromedian line, posterior to the basis capituli.

Goblets: Small, round structures located in the spiracular plate. They may be very small and numerous as in Dermacentor variabilis, or relatively large and few as in D. nitens.

Hexagonal: Having six sides.

Hood: Anterior projection of the integument on some soft-bodied ticks.

Hypostome: Median ventral structure of the mouth parts that lies parallel to and between the palpi and is immovably attached to the basis capituli. It bears recurved "teeth" or denticles. (See dentition.)

Inornate: Absence of a color pattern on the scutum.

Integument: Outer covering or cuticle of the tick body.

Lateral: Toward the side.

Legs: Segmented appendages of which nymphs and adults have four pairs and larvae have three pairs. From anterior to posterior the legs are identified by Roman numerals I, II, III, and IV. The segments from the proximal (next to the body) to the distal end are called coxa, trochanter, femur, tibia, metatarsus, and tarsus.

Macula: Large sclerotized structure located in the spiracular plate. It may be of variable size, shape, and location.

Mammillate: With nipplelike protuberances or processes.

Medial: Toward the median axis of the body.

Median: The longitudinal axis that divides the body into symmetrical halves.

Morphological: Pertaining to form or structure.

Ornamentation: Enamel-like color pattern that is superimposed on the base color of the integument in hard ticks. When present, this color pattern is usually pale although it may be "dirty" white, gray, yellow-gray, or green-gray. (See inornate and ornate.)

Ornate: Definite color pattern superimposed on the base of the integument in hard ticks. (See ornamentation.)

Palpi or palps (sing. palpus): Paired articulated appendages located antero-laterally upon the basis capituli and lying parallel with the hypostome. Four distinct segments are present in soft ticks. In all hard ticks the 4th segment is reduced to a small hair-crowned papilla lying in a cuplike depression of segment 3. The sequence of numbering of the segments is indicated by Arabic numerals 1, 2, 3, and 4: 1 being the proximal segment (closest to the basis capituli).

Periphery: Circumference or outer margin.

Porose areas: A pair of pitted areas, usually depressed and oval, on the dorsal surface of the basis capituli; present in all adult female hard ticks; absent in male and immature stages.

Posterior: Toward the rear end.

Protuberance: Any elevation above the surface.

Proximal: Nearest to the point of attachment or origin.

Punctations: Pits in the surface of the exoskeleton, frequently present on the scutum and sometimes present on the basis capituli of some of the hard ticks. The pits may be deep or shallow, small or large, and with or without hair.

Scapulae (sing. scapula): Anterior angles or "shoulders" of the scutum that project on either side of the emargination.

Sclerotized: Hardened in definite areas by deposition or formation of organic or inorganic substances in the cuticula (termed sclerotin).

Segment: Distinct articulated entity of a palpus or a leg.

Scutum: Heavily sclerotized dorsal plate posterior to the capitulum in hard ticks. It covers almost the entire dorsal surface in the male, about half the dorsal surface in the unengorged female. (See engorged.)

Spiracular plates: Paired respiratory organs located laterally on the venter and posterior to coxa IV in hard ticks; may be oval, rounded, or comma-shaped. In the soft ticks the spiracular plates are located ventro-laterally and opposite coxa IV and are usually round or oval.

Spurs: Projections from the posterior surface or posterior margin of the coxae; may be rounded or pointed, small or large. Projections on the median side are called internal spurs, those on the lateral side are called external spurs. Metatarsal spurs are small, pointed projections on the distal end of the metatarsus.

Striae, striate: Marked with parallel, fine, impressed lines.

Sutural line: Distinct line around the outer margin separating dorsal and ventral surfaces in Argas ticks.

Subapical dorsal protuberance: Subterminal protuberance present on the tarsus of some species of soft ticks. It should be distinguished from the dorsal humps which are present on the tarsus and metatarsus.

Subterminal: Below the end, or not quite attaining the end.

Venter: Entire ventral or under surface of the body.

Ventral: Pertaining to the underside of the body.

Ventral cornua: Very small projections arising from the postero-lateral angles of the ventral surface of the basis capituli.

KEY TO FAMILIES AND GENERA OF ADULTS

Scutum present, short in female, long in male. Capitulum at anterior of body in all stages . . . . . Family Ixodidae, p. 17

Scutum absent. Capitulum on underside of body in nymphs and adults, anterior in larvae . . . . . Family Argasidae, p. 25

FAMILY IXODIDAE

General Comments

The family Ixodidae is represented in the United States by seven genera: Amblyomma, Aponomma, Boophilus, Dermacentor, Haemaphysalis, Ixodes, and Rhipicephalus. The principal hosts of the hard ticks include mammals, reptiles, amphibians, and birds. Generally, only those species known to be of economic importance as pests to livestock are included in this manual. (See Chart, p. 33.)

Morphological Characteristics

The family Ixodidae, the so-called "hard ticks," includes those ticks that have a scutum. Sexual dimorphism is pronounced in the male. The dorsum is almost completely covered by the scutum and the body is incapable of becoming greatly enlarged. In the female the dorsum is only partially covered by the scutum and the body is capable of considerable enlargement. The scutum appears as only a small shield posterior to the capitulum. Porose areas are present on the basis capituli of the females, absent on the basis capituli of the males. The capitulum is always anterior and visible dorsally. The spiracular plates are located posterior to coxa IV.

Key to the Genera

1. Anal groove curves about the anus in front. Inornate. Eyes absent. Festoons absent. . . . . Genus Ixodes, p. 18

   Anal groove curves about the anus behind or is absent. Ornate or inornate. Eyes present or absent. Festoons present or absent 2

2. Second segment of palpi projects laterally beyond the basis capituli. Eyes absent . . . . . Genus Haemaphysalis, p. 19

   Second segment of palpi not projecting laterally beyond basis capituli. Eyes present. 3

3. Basis capituli hexagonal dorsally. Inornate. Male with adanal shields and accessory shields 4

   Basis capituli not hexagonal dorsally. Usually ornate. Male without adanal shields and accessory shields 5

4. Spiracular plate oval. Coxa I not deeply cleft. Festoons absent. Palpi very short, compressed, ridged dorsally and laterally . . . . . Genus Boophilus, p. 19

   Spiracular plate comma-shaped. Coxa I deeply cleft. Festoons present. Palpi short, broad, usually not ridged dorsally and laterally . . . . . Genus Rhipicephalus, p. 20

5. Palpi long, second segment at least twice as long as wide. Basis capituli of variable form, roughly rectangular dorsally. Ornate ..... Genus Amblyomma, p. 21

Palpi short, second segment not twice as long as wide. Basis capituli rectangular dorsally. Usually ornate ..... Genus Dermacentor, p. 23

GENUS IXODES

General Comments

The long mouth parts of the Ixodes enable these ticks to be especially painful and annoying parasites of livestock and man.

Thirty-four species of the genus Ixodes have been reported in the United States. Only two species, however, I. pacificus and I. scapularis, are commonly found on livestock. Both species are three-host ticks.

Ixodes pacificus, the California black-legged tick, is commonly found on domestic livestock, deer, and man along the western coast of the United States from Mexico to British Columbia. Records indicate that this species is most abundant during the spring.

Ixodes scapularis Say, the black-legged tick, is found primarily from Texas and Oklahoma eastward to the Atlantic Ocean, but it has been reported as far north as Iowa and Indiana and as far northeast as southern Massachusetts. In the Southern States where this species is commonly found, it is most abundant in late winter and early spring. Although the black-legged tick is not known to transmit any disease, it is a suspected vector of anaplasmosis.

Morphological Characteristics

Anal groove distinct and curving about the anus anteriorly. Inornate. Eyes and festoons absent. Palpi and basis capituli of variable form. Spiracular plates round or oval. Venter of male covered with seven non-projecting, armor-like plates. Sexual dimorphism pronounced especially in regard to the capitulum.

The Species of Ixodes

No attempt has been made to present a key for the identification of the species, because many of the numerous species of Ixodes found in the United States are closely related and difficult to differentiate. In most cases an accurate determination of an unknown specimen may be made only if known specimens are available for comparison and study. It is suggested that all Ixodes may be referred to a specialist for identification.

(See "The Genus Ixodes in North America," by R. A. Cooley and G. M. Kohls, 1945.)

GENUS HAEMAPHYSALIS

General Comments

The genus Haemaphysalis includes over 50 species. Only 2 species, H. leporispalustris and H. chordeilis, have been reported in the United States. Neither is commonly found on livestock. Both species are three-host ticks.

Haemaphysalis leporispalustris (Packard), the rabbit tick, is widely distributed in the United States from Massachusetts to California. The adult is found primarily on rabbits and ground-frequenting birds; whereas, the larva and nymph are found almost entirely on ground-inhabiting birds. None of the stages are commonly found on livestock or man. This species may be more important than is realized. Evidence indicates that the rabbit tick may be an important factor in the spread of Rocky Mountain spotted fever and tularemia among wild animal reservoir hosts.

Haemaphysalis chordeilis, the bird tick, is also widely distributed in the United States. Birds are the preferred hosts for all stages of the species, and livestock and man are only rarely attacked. Several authorities have reported deaths in turkeys and wild game birds from heavy infestations of this species.

Morphological Characteristics

Inornate. Eyes absent. Festoons present. Usually short conical palpi with second segment projecting laterally beyond the basis capituli which is rectangular in the dorsal view. Usually of small size and sexual dimorphism slight. Ventral plates or shields absent in the male. Posterior margin of coxa I never bifid or deeply cleft. Spiracular plates usually rounded or comma-shaped in the male, rounded or oval in the female.

Key

Ventral cornua present. Dentition of hypostome 3/3. . . . . Haemaphysalis leporispalustris

Ventral cornua absent. Dentition of hypostome 5/5 . . . . . H. chordeilis

GENUS BOOPHILUS

General Comments

The genus Boophilus has been eradicated from the United States--except for a small, narrow quarantine zone along the Texas-Mexico border. Periodic reinfestations in the quarantine zone occur from adjacent heavily infested areas of Mexico.

The cattle fever tick, B. annulatus (Say), was formerly the most common and economically important tick attacking livestock, particularly cattle, in the Southern States. As a vector of Babesia bigemina, the causative agent of cattle fever (bovine piroplasmosis), this tick and the disease it transmits cost the livestock industry an estimated $40 million annually prior to the start of the Tick Eradication Program in 1906.

Boophilus microplus (Canestrini), the tropical cattle tick, has also been found in the United States. It is closely related to B. annulatus, and the females are sometimes difficult to differentiate. Both species are one-host ticks that prefer similar hosts, and both species are vectors of piroplasmosis and anaplasmosis.

As the name implies, the tropical cattle tick prefers a warm climate. In the United States, in the past, it was reported most frequently from Florida and extreme southern Texas. The tropical cattle tick is very prevalent in the Caribbean islands and the West Indies, Central America, and parts of Mexico and South America; also in Australia, Africa, and the Oriental Region.

Morphological Characteristics

Very short, compressed palpi, ridged dorsally and laterally. Basis capituli hexagonal dorsally. Eyes present. Inornate. Festoons absent. Spiracular plate rounded or oval. Male with adanal and accessory adanal shields. Anal groove obsolete in female, faint in male. Caudal process present or absent in male.

Key

1. Female: With internal and external spurs of coxa I broadly rounded and wider than long. Coxae II and III with external spurs broadly rounded and wider than long. Coxa IV with or without very small external spur.
   Male: With caudal process at posterior extremity of body ..... Boophilus microplus

2. Female: With internal spur of coxa I absent, external spur broadly rounded and wider than long. Coxae II, III, IV without external spurs.
   Male: Without caudal process ..... B. annulatus

GENUS RHIPICEPHALUS

General Comments

In Africa, where this species is common, it is a known vector of bovine piroplasmosis, East Coast fever, pseudo-East Coast fever, and spirochetosis. The common hosts in Africa include numerous wild and domestic animals, including cattle, sheep, goats, swine, horses, camels, and dogs.

Until 1960 the genus Rhipicephalus held a unique position in the United States in that only one species, Rhipicephalus sanguineus, had been reported.

In 1960 an African species, R. evertsi, the red tick, was found on zoo animals in two zoological compounds in Florida. Later the red tick was found on zoo animals at a game farm in New York. The red tick was eradicated from the United States in 1961.

Morphological Characteristics

Palpi short and basis capituli usually hexagonal dorsally. Usually inornate. Eyes and festoons present. Coxa I bifid. Males with a pair of adanal shields and usually a pair of accessory shields. Spiracular plates comma-shaped, short or long.

Key

Eyes hemispherical or "bead-like," set in a depression (orbited) and protruding from it. Scutum dark brown, contrasting with reddish integument and saffron legs. Scutal punctations moderate to large in size. Adanal shields huge, very acute (pointed) anteriorly, and distinctly widened and semi-circular posterolaterally. (Found on zoo animals in Florida and New York.) . . . . . Rhipicephalus evertsi

Eyes only mildly convex and not set in a depression. Scutum, integument, and legs brown. Scutal punctations small to moderate in size, scattered and not as deep. Large adanal shields, less acute anteriorly, only slightly widened, and somewhat angular posteriorly. . . . . R. sanguineus

GENUS AMBLYOMMA

General Comments

The genus Amblyomma is represented in the United States by at least seven species, four of which are commonly found on livestock. Those found on livestock include A. americanum, A. cajennense, A. imitator, and A. maculatum. Their distribution is limited usually to the southeastern or southwestern coastal States. The long mouth parts and the color pattern on the scutum are distinctive characters which aid in recognition of Amblyomma attacking livestock in the United States. Two species, A. dissimile, the iguana tick, and A. tuberculatum, the gopher-tortoise tick, as larvae and nymphs, have attached to and engorged upon bovine. Adults, however, usually attach only to reptiles and amphibians. The engorged adult A. tuberculatum may be almost an inch in length. Another species, A. inornatum, has been collected from dog, cow, coyote, and rabbit in southern Texas.

Amblyomma americanum (Linnaeus), the lone star tick, so named because of the conspicuous pale spot on the posterior of the female scutum, is one of the more economically important species. The long mouth parts and great abundance of this tick make it an especially annoying pest of livestock. The wound produced predisposes livestock to attack by the screwworm fly, Cochliomyia (Callitroga) hominivorax.

The lone star tick is also important from the public health standpoint, because it is capable of transmitting tularemia, Rocky Mountain spotted fever, and American Q fever; and causes tick paralysis in man and in dogs.

The lone-star tick is more widely distributed in the United States than the other Amblyomma species. It is commonly found from Texas north to Missouri and eastward to the Atlantic coast. A. americanum is a three-host tick. It may be active from early spring to late fall and all stages attack livestock and man.

Amblyomma cajennense (Fabricius), the Cayenne tick, has limited distribution in the United States, being confined to a few counties in southern Texas. In tropical Central and South America, this species has been reported abundant, active the year round, and of definite economic importance as a livestock pest. It is a known vector of Rocky Mountain spotted fever in Mexico, Panama, Columbia, and Brazil. A. cajennense is a three-host tick.

Amblyomma hebraeum, the bont tick, an exotic species, has been reported twice in the United States on rhinoceroses imported from South Africa. The ticks were dead when found. This is a three-host tick that causes heartwater in cattle, sheep, and goats.

Amblyomma imitator was, until 1958, confused with A. cajennense. The species has been recorded from man and a variety of domestic and wild animals in Southern Texas, Mexico, and Central America. Its definitive distribution, life history, and economic importance have not yet been determined.

Amblyomma maculatum Koch, the Gulf Coast tick, is an important pest of livestock. The adults are usually found in clusters in the external ear where they produce an intense inflammation. Tick bites predispose the ear to attack by the screwworm fly.

The Gulf Coast tick is found in those States bordering the Gulf of Mexico and along the Atlantic Coast of South Carolina, Georgia, and Florida. This species is rather exacting in its environmental requirements, usually preferring areas of high rainfall, temperature, and humidity. It is seldom found in great number more than 100 to 150 miles from the coast. Livestock are attacked principally during the late summer and early fall. A. maculatum is a three-host tick. The larva and nymph generally feed on birds and small mammals while the adult prefers livestock.

Morphological Characteristics

Palpi long, segment 2 at least twice as long as wide. Generally ornate. Eyes and festoons present. Basis capituli of variable form, usually roughly triangular or rectangular dorsally. Adanal shields absent in the male, but small ventral plaques occasionally present near the festoons. Spiracular plates roughly triangular or comma-shaped.

Key to the Female Species

1. Scutum with scant ornamentation usually limited to a distinct pale spot near the posterior end . . . . . Amblyomma americanum

   Scutum with pale ornamentation in an extensive pattern 2

2. Metatarsi of legs II, III, and IV with two stout spurs on distal end. . . Amblyomma maculatum

   Metatarsi of legs II, III, and IV without spurs on distal end 3

3. Festoons with chitinous tubercles at postero-internal angle. . . . . Amblyomma cajennense

   Festoons without chitinous tubercles . . . . . Amblyomma imitator

Key to the Male Species

1. Metatarsi of legs II, III, and IV with two stout spurs on distal end. Coxa I with internal spur short, insignificant ..... Amblyomma maculatum

   Metatarsi of legs II, III, and IV without spurs on distal end. Coxa I with internal spur moderately long 2

2. Scutum with abundant pale markings more or less radiating from the center. Markings most prevalent in central and anterior area of scutum ..... Amblyomma cajennense* or Amblyomma imitator

   Scutum with sparse pale markings, usually four or more symmetrically isolated pale patches. Anterior and central area of scutum without pale markings ..... Amblyomma americanum

GENUS APONOMMA

This genus closely resembles Amblyomma except that eyes are absent. It is found almost exclusively on reptiles and is of no known veterinary or medical importance. It is mentioned here only because of its resemblance to Amblyomma. One species, Aponomma elaphensis Price is known to be established in the continental United States.

GENUS DERMACENTOR

General Comments

The genus Dermacentor comprises an important group of ticks in the United States, particularly as vectors of disease-producing organisms affecting man. Several of the species are known transmitters of Rocky Mountain spotted fever, tularemia, Colorado tick fever, and Q fever; some species may produce tick paralysis. Several members of this genus are also important pests of livestock, both as disease vectors and as bloodsucking parasites.

This genus is represented in the United States by at least nine species, six of which commonly attack livestock. D. venustus (= andersoni), D. occidentalis, and D. variabilis are three-host ticks. D. albipictus and the closely related D. nigrolineatus, as well as D. nitens, are one-host ticks. The three additional species D. halli, D. hunteri, and D. parumapertus do not commonly attack livestock.

Dermacentor (Anocentor) nitens, the tropical horse tick, is an important parasite of horses, mules, and asses in parts of Mexico, Central America, and the West Indies. Until recently, it was believed the tropical horse tick was established in the United States only in extreme southern Texas. Evidence now indicates that this species is also well established in southern Florida. D. nitens is a one-host tick. It is usually found in the ears of horses, mules, and asses, although it has also been found on cattle, goats, and deer. In heavy infestations on horses it has also been found in the nasal diverticulae, the mane, the perineal region, and along the ventral mid-line.

*Differentiation of males A. cajennense and A. imitator is difficult. Males of A. imitator usually are paler, narrower, and smaller. Refer to Glen M. Kohls' original description of A. imitator (see references) for additional information on the separation of the two species.

Dermacentor albipictus, the winter tick, is an important pest of horses, cattle, moose, elk, and deer in the northern and western United States. It is often abundant on range stock and, if not controlled, may cause losses through weakened condition or death of the host. D. albipictus is a one-host tick. The adult is most active during the late fall, winter, and early spring when the adult females are actively engorging. It is suspected of transmitting a disease of moose in Minnesota.

Dermacentor nigrolineatus, the brown winter tick, is closely related to D. albipictus. In fact, some systematists regard D. nigrolineatus as a variation or "form" of D. albipictus. Other authorities regard the completely inornate D. nigrolineatus as a valid species.

The brown winter tick is widely scattered throughout the eastern half of the United States, both North and South, although the incidence of this species is greater in the Southeastern quarter of the country. In southwestern Texas and New Mexico, the distribution of D. albipictus and D. nigrolineatus may have overlapped with a crossing of the two species resulting in a fertile hybrid which is sometimes difficult to place in either species.

The preferred host for the brown winter tick in the Southeastern States is the white-tailed deer, although it will also attack horses, mules, and cattle. D. nigrolineatus is a one-host tick and is found on animals only during fall, winter, and spring.

Dermacentor occidentalis, the Pacific Coast tick, is common from Oregon to lower California. This species occurs on a variety of domestic animals with occasional heavy infestations on deer. Adult ticks are most numerous on hosts during the rainy season. All stages of the tick have been reported on cattle. This is a three-host tick.

Dermacentor variabilis, the American dog tick, is widely distributed in the United States. It is found in all the States east of the Rocky Mountains, as well as in California and Oregon. The American dog tick is an important vector of Rocky Mountain spotted fever in the Eastern States. It also transmits tularemia and bovine anaplasmosis and may produce tick paralysis. D. variabilis is a three-host tick. Although the dog is the principal host for the adult tick, man as well as domestic and wild animals are frequently attacked. The larva and nymph prefer small rodents, especially mice, rats, and rabbits.

Dermacentor venustus (= andersoni), the Rocky Mountain wood tick, is one of the most infamous transmitters of diseases of man in the United States. It is a vector of Rocky Mountain spotted fever, tularemia, Colorado tick fever, and Q fever, and produces tick paralysis in both man and animals. It is also a vector of anaplasmosis in cattle.

This species has been reported in 14 Northwestern States and in three provinces of southwestern Canada. D. venustus (= andersoni) is a three-host tick. The nymph and larva feed primarily on small animals, such as squirrels, chipmunks, and rabbits; whereas, the adults generally attack the larger mammals--horses, cattle, sheep, deer, and man.

Morphological Characteristics

Basis capituli rectangular dorsally. Eyes and festoons present. Palpi short, broad, or moderate. Coxae I to IV of some species of males increase progressively in size; in all species coxa IV is the largest. Male without ventral plates or shields. Coxa I bifid in both sexes. Spiracular plates ovate or comma-shaped. Usually ornate.

Key

1. Spiracular plate with distinct dorsal prolongation 2

   Spiracular plate without distinct dorsal prolongation 4

2. Cornua long, especially in male (Found along Pacific Coast of California and Oregon)..... Dermacentor occidentalis

   Cornua short or moderate in length..... 3

3. Spiracular plate with broad dorsal prolongation and goblets very small and numerous ..... Dermacentor variabilis

   Spiracular plate with narrow dorsal prolongation and goblets of moderate size and number ..... Dermacentor venustus (= D. andersoni)

4. Scutum conspicuously marked with white in both sexes ..... Dermacentor albipictus*

   Scutum without white, or with very little white 5

5. Spiracular plate with only a few, very large, (usually 4 to 10) isolated goblets. Seven festoons present. Scutum without white. Spurs on coxa I widely divergent..... Dermacentor (Anocentor) nitens**

   Spiracular plate with many more crowded, medium-sized goblets. Eleven festoons present. Scutum usually without white. Spurs on coxa I not widely divergent.....Dermacentor nigrolineatus ***

FAMILY ARGASIDAE

General Comments

The family Argasidae is represented in the United States by three genera which have been found on livestock--Argas, Otobius, and Ornithodoros.

The fowl tick, Argas persicus, is sometimes a serious pest of domestic fowl. The spinose ear tick, Otobius megnini, is the only soft tick commonly found on livestock in the United States. Ticks of the genus Ornithodoros are not usually important parasites of livestock, although several species are important vectors of the spirochetes of relapsing fever in man.

The principal hosts of the soft ticks include birds, rodents, and bats--occasionally livestock and man. (See Chart p. 36.)

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* See page 23 for discussion of Dermacentor albipictus and D. nigrolineatus.

** Some systematists place D. nitens in the genus Anocentor.

*** See page 23 for discussion of D. nigrolineatus.

While it is generally accepted that hard ticks have only one nymphal stage, soft ticks may have several. Thus, soft ticks are referred to as multi-host ticks rather than one, two, or three-host ticks.

Soft ticks are generally nocturnal in their habits. They usually feed several hours at night while the host is sleeping and then retreat before daylight to cracks and crevices in the host's habitat until ready for the next blood meal. Under laboratory conditions, investigators have maintained soft ticks for several years with only a few intermittent blood meals.

The spinose ear tick is an exception to this general life history pattern. As a larva it crawls into the host's ear where it feeds and develops through the nymphal stages. After the second nymphal stage has fed, which is from 1 to 7 months after the larva has entered the ear, the engorged nymph drops to the ground and molts to the non-parasitic adult stage.

Morphological Characteristics

The family Argasidae, or "soft ticks," consists of those ticks that lack a scutum. Sexual dimorphism is not marked. The males closely resemble the females. Porose areas are absent. The capitulum of the nymphs and adults is always ventral and not visible dorsally, except for the distal end of the palpi, which sometimes project beyond the anterior margin of the body. The capitulum is anterior in the larvae. The spiracular plates usually are located anterior to coxa IV.

Key

1. Margin of body thin and acute with a definite sutural line separating the dorsal and ventral surfaces ..... Genus Argas, p. 26

   Margin of body thick, rounded, and without a definite sutural line separating the dorsal and ventral surfaces..... 2

2. Integument of nymph covered with spines. Adult with granular integument and poorly developed hypostome..... Genus Otobius, p. 27

   Integument of nymph and adult mammillated and without spines. Adult with well-developed hypostome..... Genus Ornithodoros, p. 27

GENUS ARGAS

General Comments

Three species of Argas have been reported in the United States. The fowl tick, Argas persicus, is the only one of economic importance and is most prevalent in the Southwestern States and Florida. While it parasitizes several species of wild birds, Argas persicus is primarily a pest of domestic fowl and can be a serious problem. Argas may live more than 2 years without food. No key for this species is included.

Morphological Characteristics

Body distinctly flattened with dorsal and ventral surfaces approximately equal in area. Margin of body flattened and composed of radial striae or quadrangular plates. Sutural line present. Integument leathery, minutely wrinkled in folds, often intermingled with small, rounded "buttons," each with a pit on top and often bearing a hair in the pit. Eyes absent. Sexes similar. Nymphs and adults similar.

GENUS OTOBIUS

General Comments

The genus Otobius, sometimes classified as Ornithodoros, has two species in the United States, O. megnini and O. lagophilus. The spinose ear tick, Otobius megnini, is a common and important pest in the Southwestern States. It is primarily restricted to livestock, particularly cattle and horses, although other domestic and wild animals are attacked. The nymph is the stage usually found in the ears of livestock and is easily recognizable by the spines on the integument and the violinlike shape of the body. The adult has a poorly developed hypostome, lacks spines, and is non-parasitic.

Otobius megnini, is the only species of Otobius reported on livestock in the United States. No key is included for the species.

Otobius lagophilus is found on rabbits in the western United States.

Morphological Characteristics

Integument of adult granulated. Integument of nymph covered with spines. Sexes similar. Capitulum distant from the anterior margin in adults, near the margin in nymph. Hood and eyes absent. Hypostome well developed in nymphs, vestigial in adults.

GENUS ORNITHODOROS

General Comments

This genus is well represented in the United States, especially in the Southwestern and Western States. Several species occasionally attack livestock, but generally Ornithodoros are not a problem. This genus is significant primarily as vector of the spirochetes of relapsing fever in man.

Ornithodoros turicata, the relapsing fever tick, and O. talaje, which has no common name, occasionally attack domestic animals in the United States. These species have been reported from the Southwestern States and Florida. They are not known vectors of livestock diseases, but are vectors of relapsing fever in man in the Southwestern States.

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O. coriaceus, the pajaroello tick, has been taken from cattle and deer in California and the Pacific Coast region of Mexico. It readily attacks man and its venomous "bite" is said to be very painful. This tick, however, is not known to be a disease vector.

Morphological Characteristics

Capitulum either subterminal or distant from anterior margin. Hypostome well developed and essentially alike in both adult sexes and in nymphs. Integument with discs and mammillae commingling in a variety of patterns. Hood, camerostome, and cheeks present or absent. Eyes present or absent. Dorsal humps and subapical dorsal protuberances on legs progressively more prominent in successive nymphal stages. Body more or less flattened but strongly convex dorsally when distended. Integumental pattern continuous over sides from dorsal to ventral surfaces. Sutural line separating dorsal and ventral surfaces absent.

Key

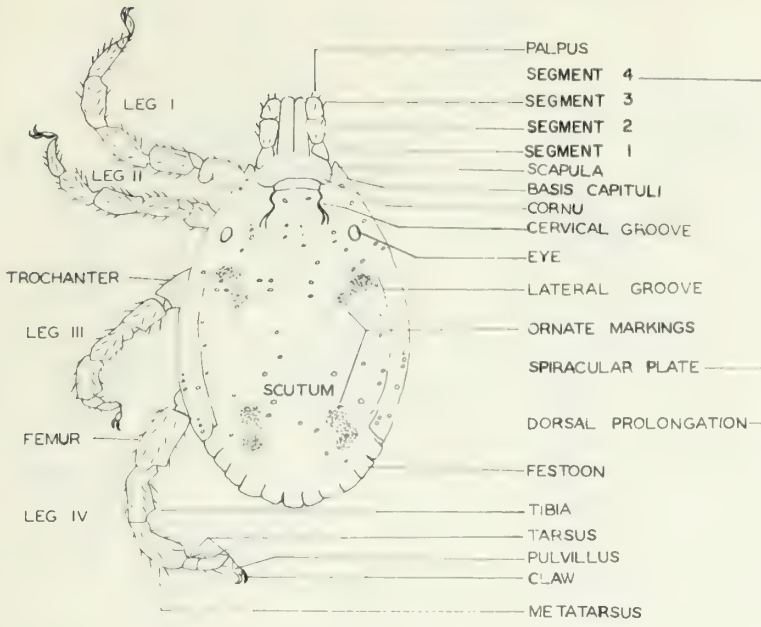
1. Cheeks present..... Ornithodoros talaje

   Checks absent..... 2

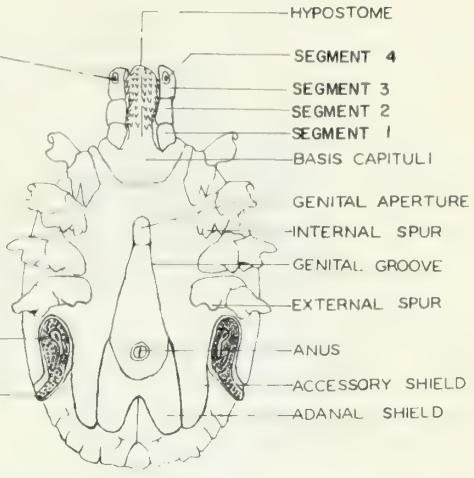
2. Eyes present (on sides of body above second and third coxae).
   Tarsus IV with prominent subapical dorsal protuberance.
   (Reported from Pacific Coast of California and Mexico)..... Ornithodoros coriaceus

   Eyes absent. Tarsus of leg IV without subapical dorsal
   protuberance..... Ornithodoros turicata

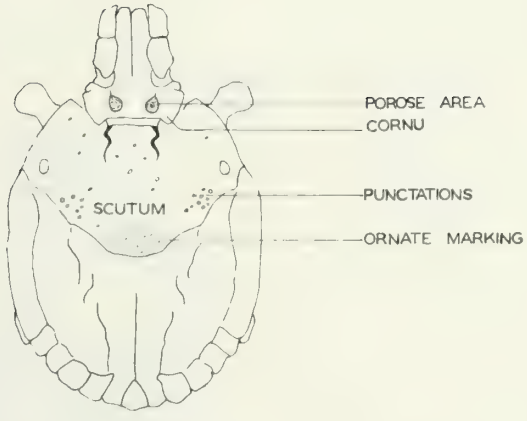
HYPOTHETICAL MALE AND FEMALE IXODIDAE (HARD TICKS) WITH KEY CHARACTERISTICS LABELED



DORSUM OF MALE



VENTER OF MALE



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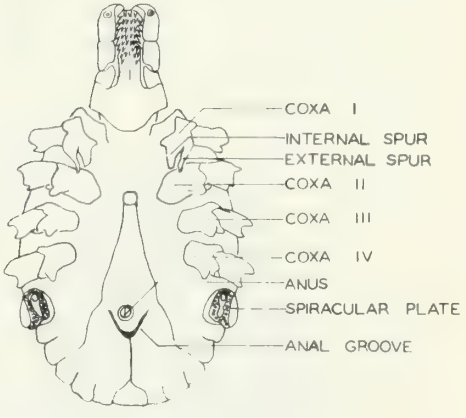
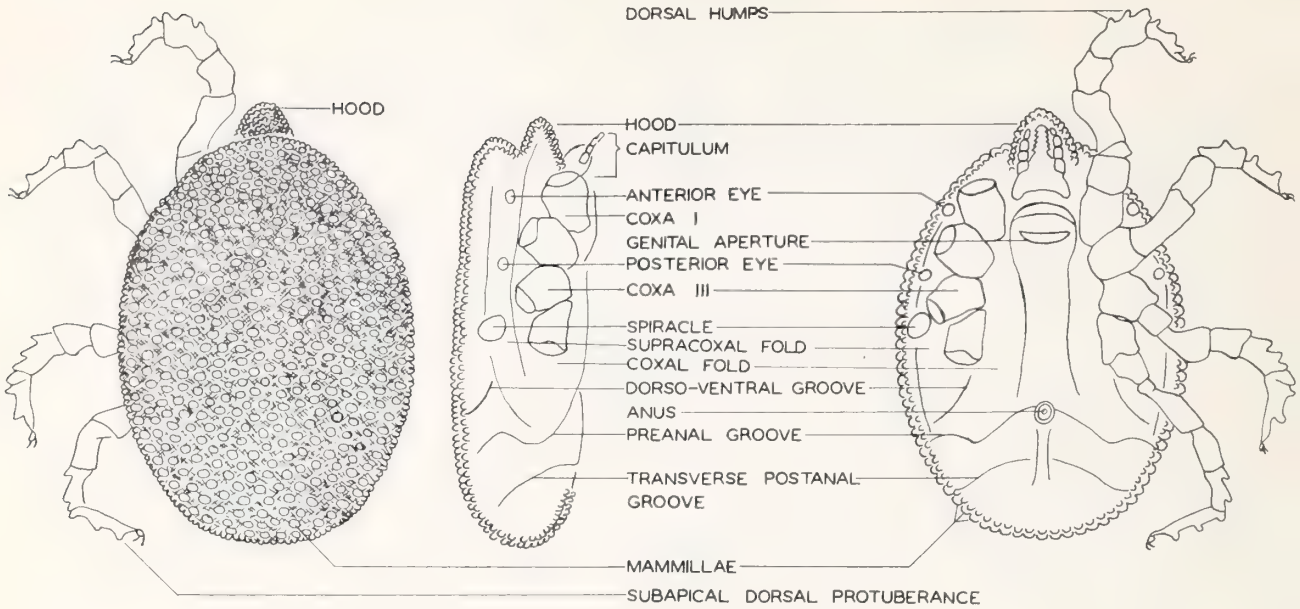
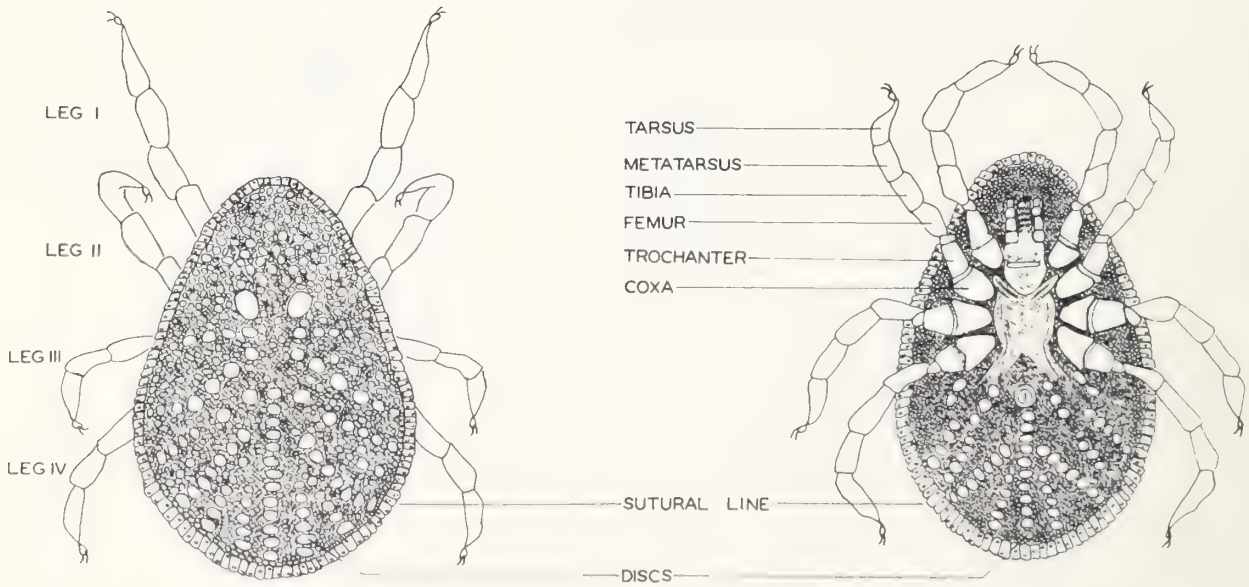


VENTER OF FEMALE

HYPOTHETICAL SOFT TICKS WITH KEY CHARACTERISTICS LABELED

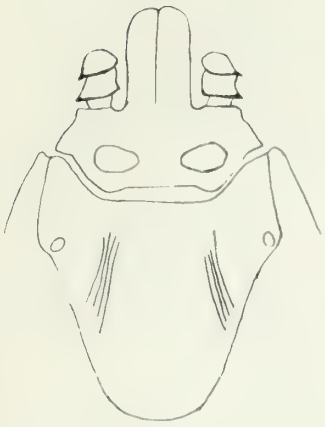


DORSUM LATERAL VIEW VENTER

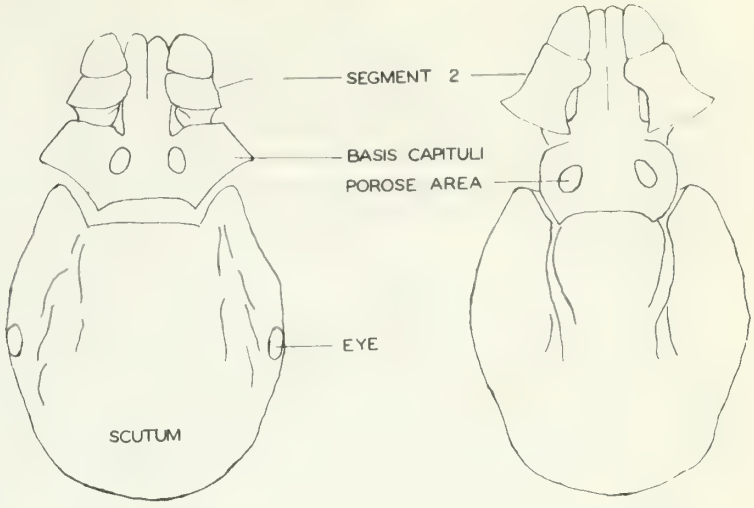


DORSUM VENTER

DORSAL VIEW OF THE SCUTA AND CAPITULA OF SOME FEMALE IXODIDAE (HARD TICKS), SHOWING CHARACTERISTICS OF THE GENERA

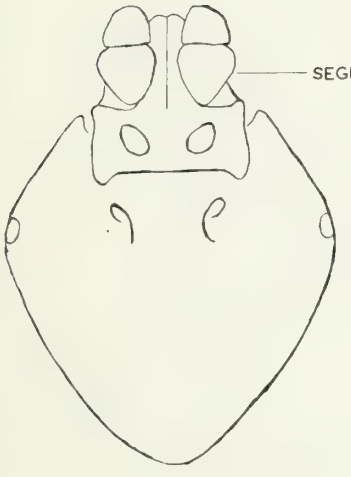


BOOPHILUS

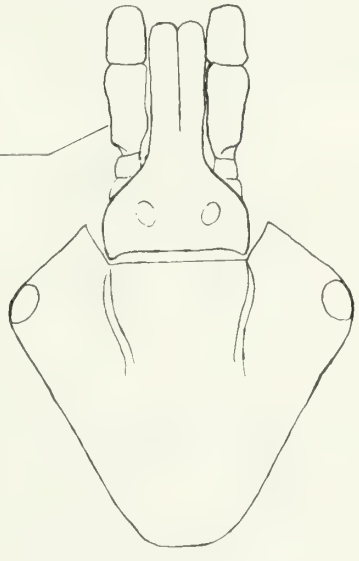


RHIPICEPHALUS

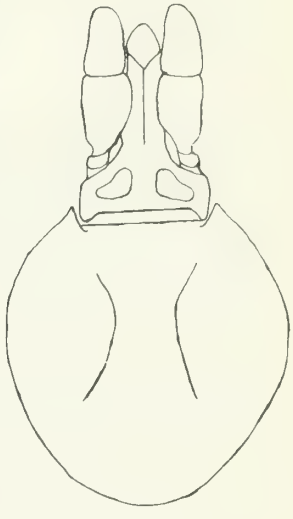
HAEMAPHYSALIS



DERMACENTOR



AMBLYOMMA



IXODES

COLLECTING AND PRESERVING TICKS

Finding ticks on an animal often requires careful examination of all parts of the animal. Some species of ticks, as the spinose ear tick, tropical horse tick, and the larval and nymphal stages of the red tick, are almost always attached in the inner ear of the host. Other species prefer the thin skin between the hind legs, under the base of the tail, or on the brisket. Some ticks have been collected from the eyelids and the tongue of animals. In inspecting an animal for ticks use the fingers, as well as the eyes, for often a tick that cannot be seen may be felt. If possible, watch a trained tick inspector at work and note how carefully he moves his fingers over an animal.

Female ticks, ordinarily much larger than the males, are easy to find. Careful scrutiny of the area near the female frequently will also reveal a tiny male tick.

Remove ticks from the host carefully so as not to break off the capitulum (false head), especially in removing ticks with long mouthparts like the Ixodes and Amblyomma species. Forceps are useful to grasp the tick near the head end and "tease" it off. Ticks with short mouthparts, like the cattle fever tick, are readily removed without injury.

Ticks often may be collected from grass and other vegetation, where they are awaiting a host, by dragging a flannel cloth (about 30" x 5') over the area. The drag is made by attaching one end of the flannel cloth to a piece of wood, like a broom-stick, to which a strong cord or towline is attached.

Pill boxes, blood vials, or screw-cap glass vials are satisfactory containers for tick specimens. Cattle fever ticks and other disease vectors, however, should be put in screw-cap glass vials containing a preserving fluid, before removal from an infested property. Tick specimens can be preserved in 70 percent isopropyl alcohol (rubbing alcohol).

Each tick or group of ticks collected from an animal should be properly labeled with the following:

	Example
(1) Name of host.	Cow, Hereford.
(2) Geographical location where ticks are collected (city, county, and State).	Fort Worth, Tarrant County, Tex.
(3) Owner's name and address.*	Rufus Snow, Dallas, Tex.
(4) Number of specimens.	6 ticks.
(5) Collector's name.	Andy Hale.
(6) Date collected.	October 23, 1964

Ticks from different species of hosts should never be mixed. For example, ticks collected from cattle should not be mixed with ticks collected from horses.

In determining the distribution of a species of tick, any additional information is valuable. For example, four ticks were collected from inside ear and two ticks from between hind legs of a young Hereford cow. Animal pastured in dense woodland and only 1 in herd of 20 found to be infested. This animal was purchased about 1 month ago from C. O. Brown farm at Ft. Worth, Tex.

Animal Disease Eradication Division personnel are urged to submit tick specimens with a completed copy of ADE Form 5-38, Ectoparasite Collection Report.

For information on submitting specimens refer to the section, "Identification of Ticks," see page 9.

* This may not always be the same as (2).

HOSTS, DISTRIBUTION, AND DISEASES TRANSMITTED BY HARD TICKS FAMILY IXODIDAE

Scientific name	Common name	Current Distribution	Common hosts[1]	Diseases produced or transmitted
Amblyomma americanum (Linnaeus	Lone star tick.	Texas, north to Iowa and eastward to Atlantic coast. Mexico, Central and South America.	Cat, cattle, deer, dog, goat, horse, man, mule, rabbit, sheep, squirrel, swine, quail, wild turkey, and other ground-inhabiting birds.	Rocky Mountain spotted fever, Q fever, tularemia, and tick paralysis. Suspected vector of Bullis fever.
Amblyomma cajennense (Fabricius)	Cayenne tick.	Southern Texas, Mexico, Central and South America.	Cattle, deer, dog, goat, horse, man, peccary, sheep, and swine.	Spotted fever. Experimentally transmits Chagas' disease, Q fever, and brucellosis.
Amblyomma hebraeum Koch	Bont tick.	South Africa. Also found in USA on two occasions on rhinoceroses imported from Africa. Not established in USA.	Large variety of African wild animals, as well as ass, cattle, dog, goat, horse, and sheep.	Heartwater of cattle, sheep, and goats.
Amblyomma imitator	None.	Southern Texas, Mexico, and Central America.	Cattle, dog, donkey, goat, horse, man, opossum, peccary, and squirrel.	Unknown.
Amblyomma maculatum Koch	Gulf Coast tick.	Gulf Coast States of USA, Arkansas, Georgia, South Carolina. Central and South America.	Cattle, deer, dog, goat, horse, man, mule, sheep, and swine. Immature stages on ground-inhabiting birds.	Tick paralysis.
Boophilus annulatus (Say)	Cattle fever tick.	Mexico, Central and South America, Africa.	Cattle, deer, goat, horse, mule, and sheep.	Bovine piroplasmosis. Bovine anaplasmosis.

[1] Common hosts are not necessarily listed in order of importance or preference.

HOSTS, DISTRIBUTION, AND DISEASES TRANSMITTED BY HARD TICKS
FAMILY IXODIDAE--Continued.

Scientific name	Common name	Current Distribution	Common hosts[1]	Diseases produced or transmitted
Boophilus microplus (Canestrini)	Tropical cattle tick.	Mexico, Central and South America, Australia, Africa.	Cattle, deer, dog, goat, horse, and mule.	Bovine, equine, and ovine piroplasmosis. Bovine anaplasmosis. Bovine theileriasis.
Dermacentor albipictus (Packard)	Winter tick.	Primarily Northern and Western USA. Canada.	Cattle, deer, elk, horse, and moose.	Bovine anaplasmosis. "Moose paralysis."
Dermacentor nigrolineatus Packard	Brown winter tick.	Texas, Oklahoma, Kansas, and large area of eastern half of USA. Mexico.	Antelope, cattle, deer, elk, horse, and mule.	Bovine anaplasmosis.
Dermacentor (Anocentor) nitens Neumann	Tropical horse tick.	Southern Texas, Florida, West Indies, Mexico, Central and South America.	Cattle, goat, horse, and mule.	Equine piroplasmosis.
Dermacentor occidentalis Marx	Pacific Coast tick.	California and Oregon.	Cattle, deer, dog, horse, man, mule, and rabbits.	Tick paralysis. Q fever. Reported vector of bovine anaplasmosis.
Dermacentor variabilis (Say)	American dog tick.	Widely distributed, especially in Eastern two-thirds of USA. Also, California, Oregon, Canada, and Mexico.	Cattle, coyote, dog, fox, horse, man, mice, opossum, rabbits, rats, and squirrels.	Rocky Mountain spotted fever, tularemia, bovine anaplasmosis, tick paralysis, and canine piroplasmosis.
Dermacentor venustus Banks Syn. Dermacentor andersoni Stiles	Rocky Mountain wood tick.	Northwestern USA and adjacent Western States. British Columbia and Manitoba, Canada.	Antelope, cattle, coyote, deer, elk, goat, horse, man, mice, rabbits, squirrels, woodchuck, and wood rats.	Rocky Mountain spotted fever, Colorado tick fever, tularemia, Q fever, bovine anaplasmosis, tick paralysis, canine piroplasmosis, Japanese type B encephalitis (western variety).

[1] Common hosts are not necessarily listed in order of importance or preference.

HOSTS, DISTRIBUTION, AND DISEASES TRANSMITTED BY HARD TICKS
FAMILY IXODIDAE--Continued.

Scientific name	Common name	Current Distribution	Common hosts[1]	Diseases produced or transmitted
Haemaphysalis leporispalustris (Packard)	Rabbit tick.	Widely distributed in USA, Canada, and Mexico.	Rabbits, wild birds, rarely other mammals.	Tularemia, Rocky Mountain spotted fever, Q fever.
Haemaphysalis chordeilis (Packard)	Bird tick.	Widely distributed in USA and Canada, Alaska, and South America.	Various ground inhabiting birds, rarely man and livestock.	
Ixodes pacificus Cooley and Kohls	California black-legged tick.	Washington, Oregon, California, and British Columbia, Canada.	Cattle, deer, dog, horse, and man.	Suspected vector of tularemia.
Ixodes scapularis Say	Black-legged tick.	Primarily Southeastern and Southern USA.	Cattle, deer, dog, fox, goat, horse, man, mice, opossum, racoon, rats, and squirrel.	Experimentally bovine anaplasmosis and tularemia.
Rhipicephalus evertsi Neumann	Red tick.	Africa. Found in USA in 1960; eradicated in 1962.	Large game animals, including antelope, giraffe, warthog, and zebra. Also cane rat, cattle, goat, horse, and sheep.	East Coast fever, pseudo-East Coast fever, bovine piroplasmosis, anaplasmosis, and spirochetosis, equine piroplasmosis, equine spirochetosis, sheep paralysis.
Rhipicephalus sanguineus (Latreille)	Brown dog tick.	Widely distributed throughout USA and the world.	Dog, rarely man and livestock.	Canine piroplasmosis and canine paralysis. Canine rickettsiosis (in Africa). Spirochetosis of sheep, goats, horses, and cattle (in Africa). Q fever, Rocky Mountain spotted fever, tularemia, and Marseilles fever.

[1] Common hosts are not necessarily listed in order of importance or preference.

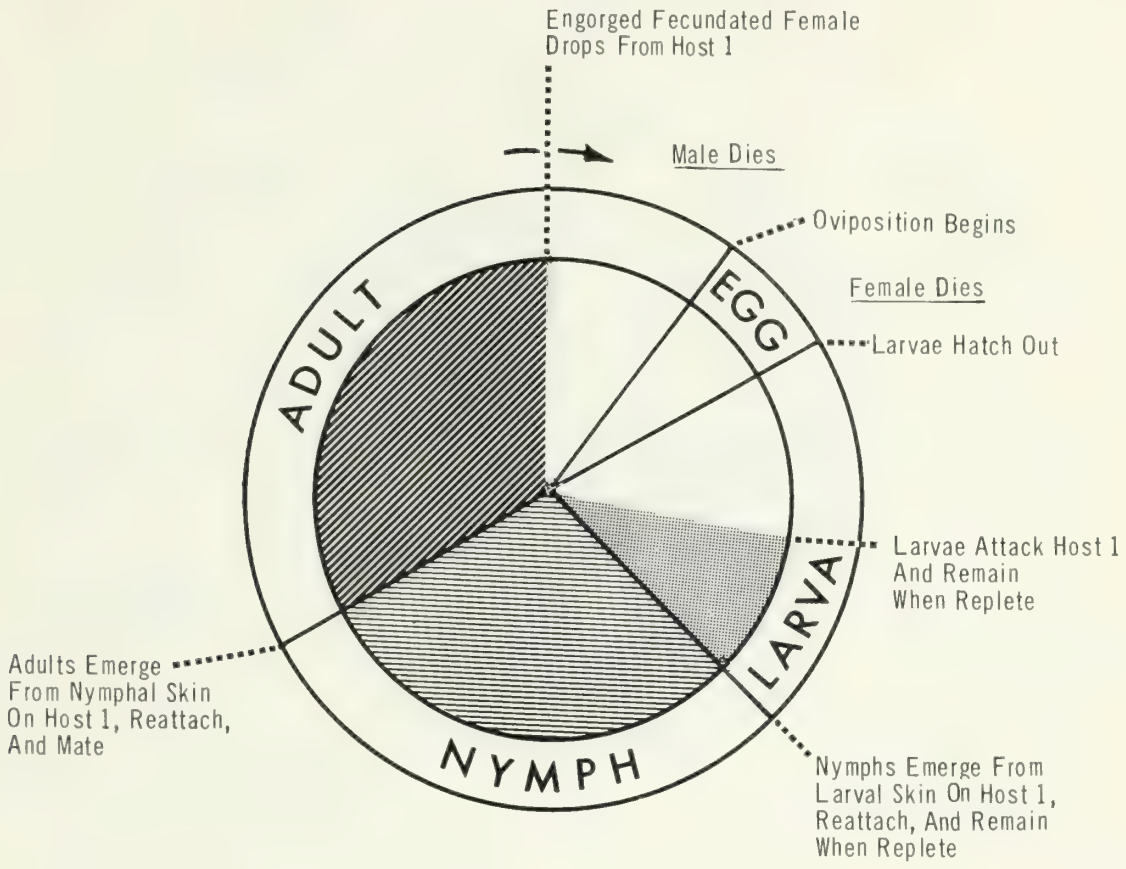
HOSTS, DISTRIBUTION, AND DISEASES TRANSMITTED BY SOFT TICKS
FAMILY ARGASIDAE

Scientific name	Common name	Current Distribution	Common hosts[1]	Diseases produced or transmitted
Argas persicus (Oken)	Fowl tick.	Southeastern and Southwestern USA, Europe, Asia, Africa, Australia, Mexico, and Central and South America.	Domestic and wild fowl, rarely man and livestock in USA.	Fowl spirochetosis, fowl piroplasmosis (Tunis and South Africa). Bovine anaplasmosis (experimental). Tick paralysis (South Africa).
Ornithodoros coriaceus Koch	Pajaroello tick.	California, Pacific coast of Mexico.	Cattle, deer, man.	Has harmful venomous "bite."
Ornithodoros talaje (Guerin-Meneville)	None.	Florida, Kansas, and Southwestern USA. Mexico, Central and South America.	Cat, chicken, dog, kangaroo rat, monkey, squirrels, and wood rat.	Relapsing fever.
Ornithodoros turicata (Dugès)	Relapsing-fever tick.	Florida and Southwestern USA. Mexico.	Cattle, horse, kangaroo rat, man, prairie dogs, rabbits, squirrels, swine, and wood rats.	Relapsing fever.
Otobius megnini (Dugès)	Spinose ear tick.	Primarily Western, but also scattered through West-central and Southeastern States.	Cat, cattle, coyote, deer, dog, donkey, goat, horse, man (rarely), sheep, and swine.	Tick paralysis. Suspected vector of Q fever.

[1] Common hosts are not necessarily listed in order of importance or preference.

SCHEMATIC LIFE CYCLES AND DISEASE TRANSMISSION OF TICKS *

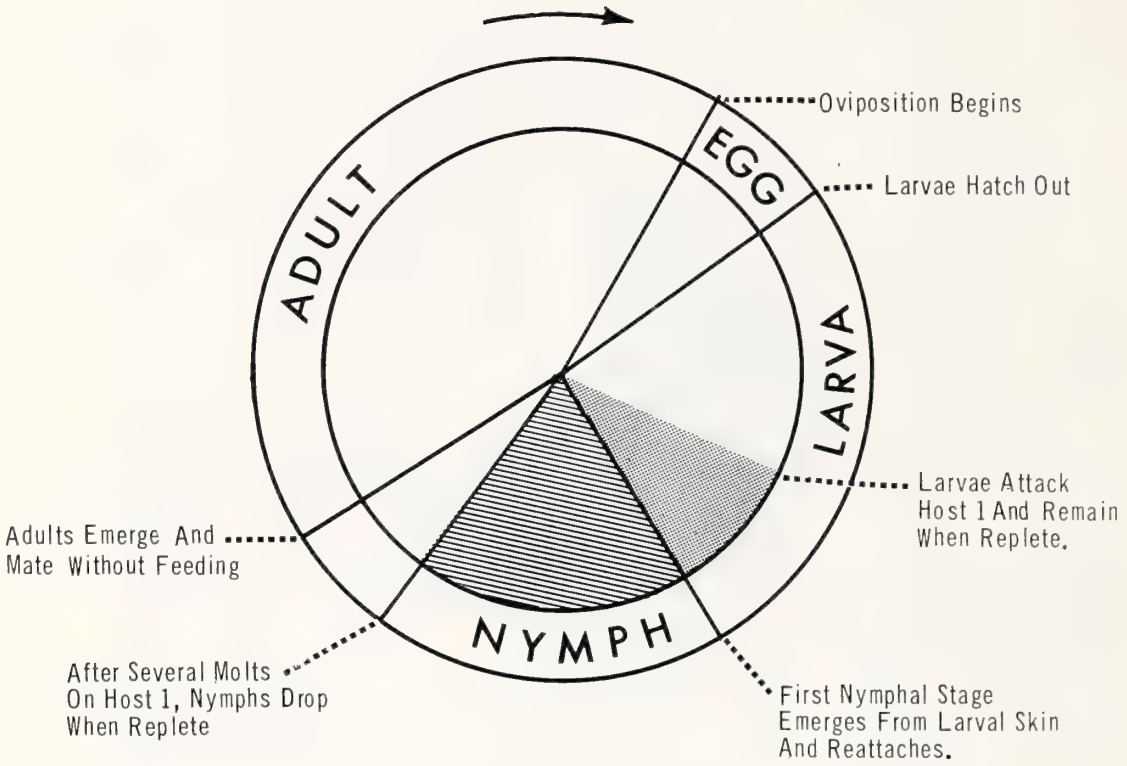
TYPE I



This type has one host and is represented by the genus Boophilus. The entire life cycle from larva to adult is spent on the same host. Feeding of the tick is twice interrupted by metamorphosis, but the possibilities for disease transmission are continuous through all stages of tick development as well as transovarially.

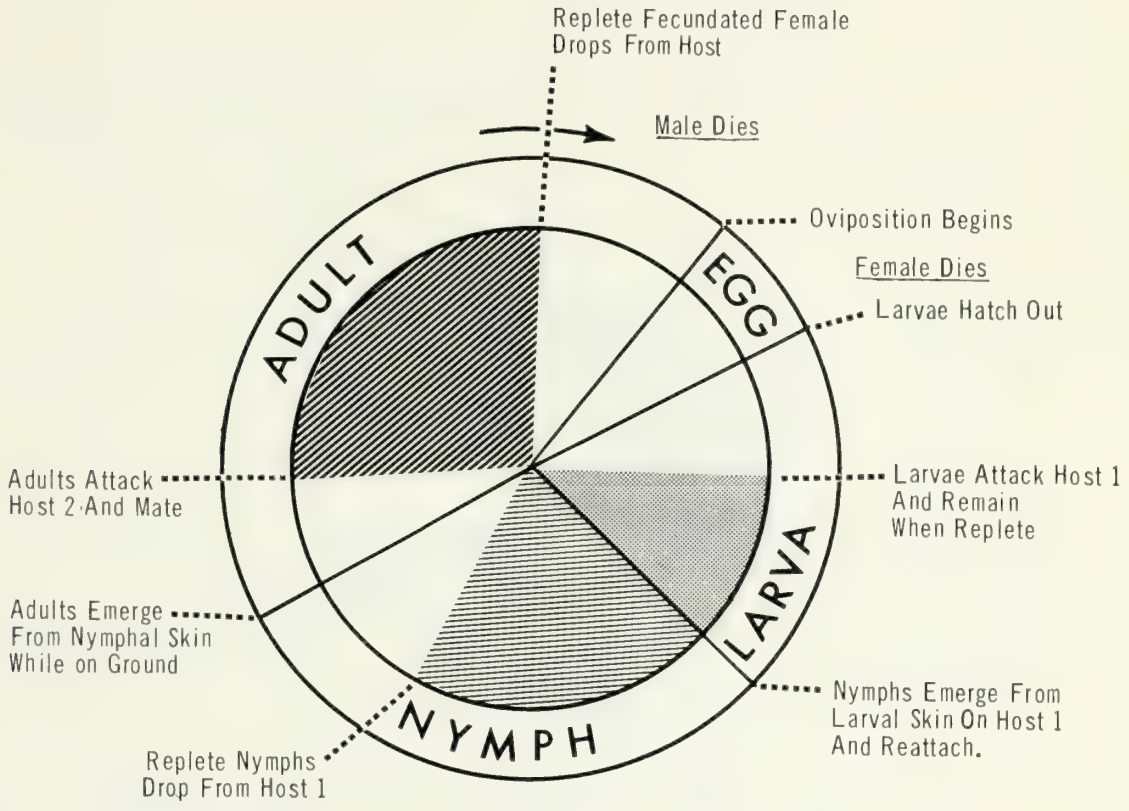
* Shaded portions of each dial represent periods of the life cycle spent in feeding on the host. (Revised after Nuttall 1911 and Pierce 1921.)

TYPE II

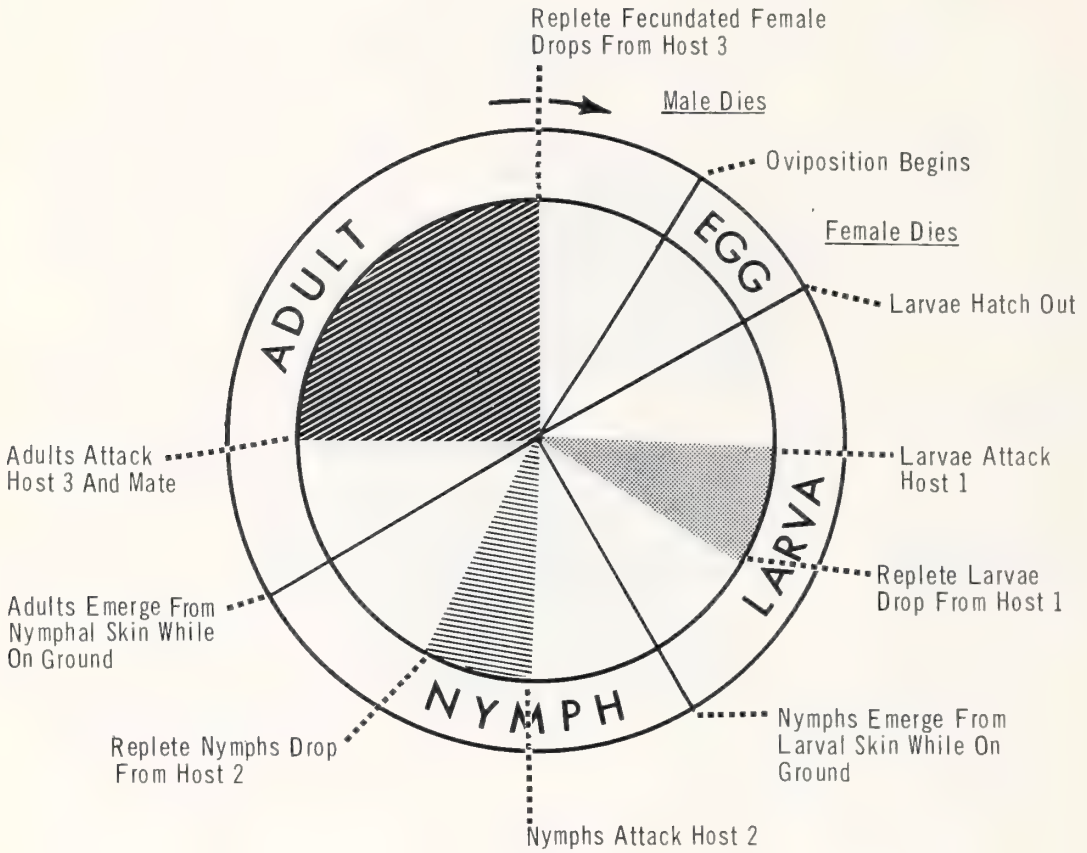


This aberrant type is found in Otobius megnini, the spinose ear tick. There is one host on which the larval and several nymphal stages feed. The adult neither attaches nor feeds. Disease organisms are taken up by the larva or nymph, remain in the tick body during transformation, enter the egg, and are transmitted by the offspring.

TYPE III

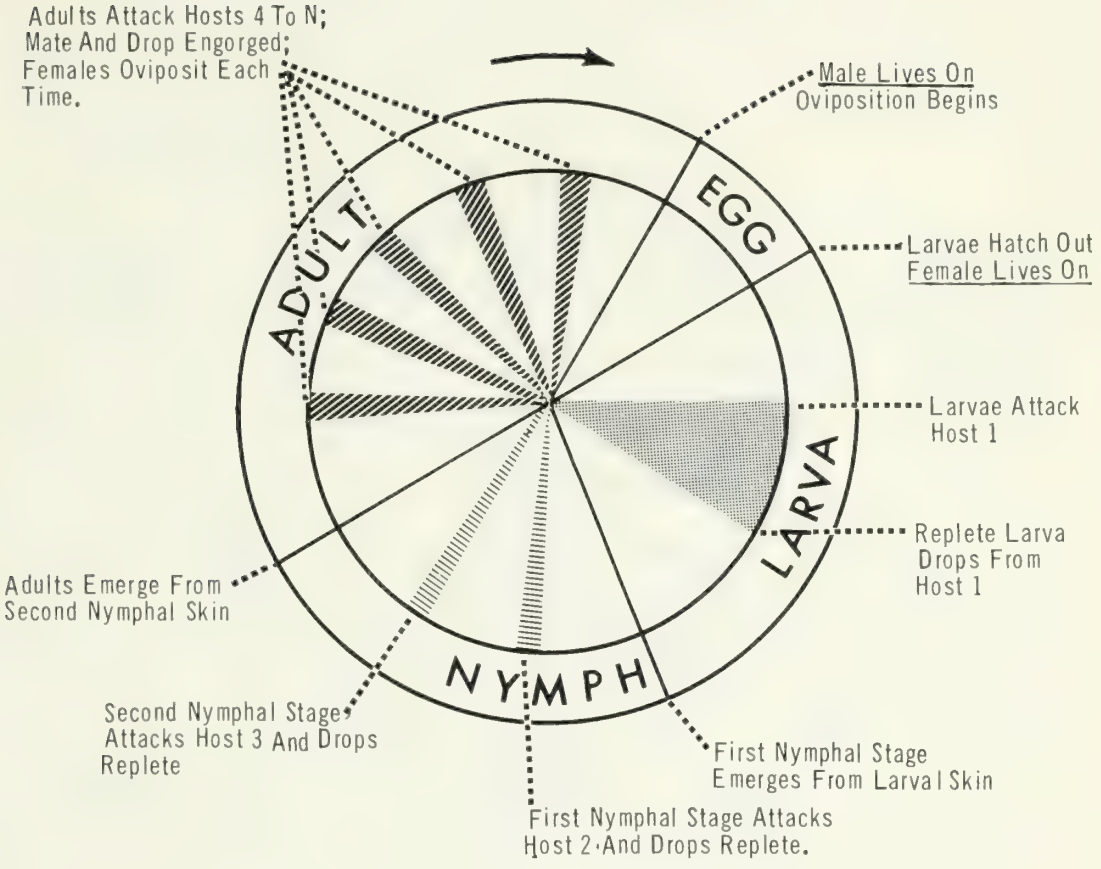


This type, found in Rhipicephalus evertsi and Hyalomma aegyptium, has two hosts. The larva and nymph develop on one host. The nymph drops when replete and the adult attaches to the second host. Disease organisms acquired by the immature stages may be transmitted by the adult to the second host. Disease organisms taken up by the adult either die or are transmitted via the egg by the offspring. Disease transfer, however, tends more toward transovarial transmission.

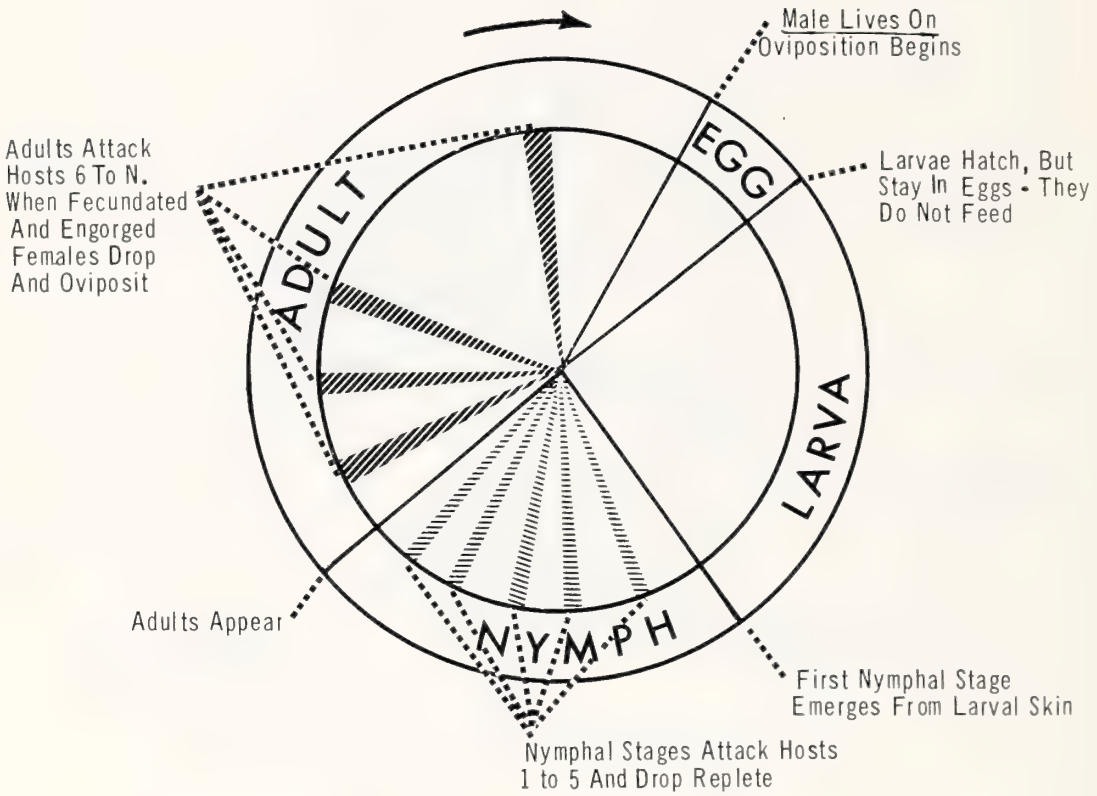


This type, the most common, is found in Rhipicephalus sanguineus, Dermacentor occidentalis, Amblyomma hebraeum, and a number of other mostly exotic species.

There are three hosts with each stage of the tick feeding on a different host. Disease organisms taken up by the nymph may be transmitted by the adult to the host. Disease organisms acquired by the adult either die or are passed transovarially to be transmitted by the offspring of the tick.



This type is found in various species of the soft tick genera Argas and Ornithodoros. There is one larval host, two nymphal hosts, and an indefinite number of adult hosts. Only the larva remains on the host to feed for any length of time. There are at least two nymphal stages. Both nymph and adult are rapid and repeated feeders. The adult lays eggs in batches after each feeding. Disease organisms taken up by anyone of these stages can be transmitted to numerous hosts by the same tick.



This type is found in two exotic species of soft ticks - Ornithodoros moubata and O. savignyi.

Since the larva does not feed there is no larval host. There are five nymphal hosts and any number of adult hosts. Nymphs and adults feed rapidly and attack a number of hosts in succession. Thus the same tick may convey disease to a number of successive hosts.

LIFE HISTORY SUMMARIES OF SOME LIVESTOCK TICKS

The data presented in each of the following life history summaries was collected from a number of sources. The intent was to present a picture of possible tick development. It should not be presumed that a particular tick actually completed all stages of its life cycle in minimum periods of time, had the greatest longevity, and simultaneously oviposited the greatest number of eggs that developed in the minimum incubation period.

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AMBLYOMMA AMERICANUM (LINNAEUS), Lone Star Tick

HABITAT

This tick is distributed from as far west in Texas as the brush grows, north to Missouri, and east in a broad belt to the Atlantic coast. It has been reported in Michigan, Illinois, and Iowa. It is believed that this species was formerly more numerous in the Northern States. The type locality is Pennsylvania or New Jersey. It has also been reported in Mexico, Guatemala, the Guianas, and Brazil.

HOSTS

This species has a wide host range, apparently attaching to any mammal with which it comes in contact. It is active from early spring to late autumn with adults dominant during spring and early summer, and the immature forms predominating later in the year. Although larvae and nymphs attach to the same hosts as the adults, larger populations of the immature stages occur on foxes and smaller mammals. Larvae alone have been reported from 40 species of birds. Specific hosts are: Cat, cattle, dog, goat, hog, horse, mule, peccary, sheep, and man; badger, bobcat, deer, fox, and wolf; chaparral cock, crow, mink, rat, skunk, squirrel, quail, wild turkey, and woodchuck.

LOCATION ON HOST

Larva, nymph, and adult favor attachment inside and outside the ears. In heavy infestations they may attach to various parts of the host but especially around the head and on the belly.

LIFE CYCLE

A. americanum is a three-host tick.

Adults engorge in 9 days and may begin egg deposition 5 days later. At a temperature of 87.7° F., a female may oviposit as many as 8,330 eggs over a period of 23 days. The average number of eggs per tick is 3,054 deposited over a period of 13.25 days.

Under laboratory conditions adults have lived 430 days; under natural conditions they would probably live longer. Females outlive males.

At a temperature of 82.5° F., eggs begin to hatch in 32 days. Although the life cycle requires three hosts, larvae and nymphs attach to the same species as do the adults. Larvae feed for 3 to 9 days. They require a blood meal to molt and to survive the winter. After dropping from the host, larvae molt in 8 to 26 days, or longer in the winter. Longevity of unfed larvae is usually 2 to 4 months, but longevity of 279 days has been recorded.

Nymphs engorge in 3 to 8 days and molt 13 to 46 days after dropping. They may live 476 days. In warm climates this tick is found in all stages of development throughout the year, although abundance may vary from season to season.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
48 to 279	3 to 9	8 to 26	3 to 476	3 to 8	13 to 46

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Days	Number	Number	Number	Days
393 to 430	9 to 24	5 to 13	7 to 28	8,330	947	3,054	23 to 117

ECONOMIC IMPORTANCE

The long mouth parts capable of deep penetration make the bite of this tick painful to man and annoying to animals. Suppurating sores form at the site of attachment inside the ears and attract screwworms. Chickens are killed by massive infestations of tick larvae.

Since Amblyomma americanum is a carrier of the rickettsia, Coxiella burnetii, causative agent of Q fever, it is suspected as a vector of the disease to man and animals. Man is possibly infected by inhalation of contaminated dusts on infected tick feces. This tick is also a vector to man of Rocky Mountain spotted fever and tularemia. In the Eastern and Southern States, A. americanum reportedly causes tick paralysis in man and in dogs. It is a suspected vector of Bullis fever.

AMBLYOMMA CAJENNENSE (FABRICIUS), Cayenne Tick

HABITAT

In the United States A. cajennense is limited to southern Texas. This species is widespread through Mexico and Central America, and is also found in the Caribbean area and throughout South America. The tick derives its name from the locality, Cayenne, Guiana, in which it was first collected.

HOSTS

Adults occur in great abundance on horses and in smaller numbers on mules, donkeys, and cattle. Other hosts for the species are dog, goat, hog, and man; anteater, capybara, coyote, deer, game cock, lion, peccary, toad, and wild turkey.

LOCATION ON HOST

Adult ticks prefer to attach between the legs or on the abdomen. However, in the equine, all stages of the tick are frequently found inside the ears and in other natural cavities, as well as on the flanks, withers, mane, and tail.

In cattle the tick may be found attached to any part of the body. This species also has been found attached to the tongues of young calves.

In the pig all stages of the tick may be found in the ears.

LIFE CYCLE

A. cajennense is a three-host tick.

If a host is available, the adult may attach within 24 hours after emergence from the nymphal skin. If the adult does not attach, it may live unfed 466 days.

The male feeds for several days to a week before seeking a mate. Mating takes place on the host and lasts 2 to 3 days.

The female can engorge in 7 to 12 days and may begin oviposition 9 days later. A maximum of 7,742 eggs may be laid. The average oviposition period is 19.7 days.

The larva emerges after an incubation period of 37 to 154 days. It may live unfed for 386 days. Upon attachment to a host, larval engorgement may be completed in 3 days on an animal host (or in 2 days on man). After dropping, the larvae cluster and become quiescent. Molting follows in a minimum of 10 days.

The nymph may live 410 days if it does not find a host. When it finds a host, the nymph may engorge in 3 days. Molting takes 12 to 105 days.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
57 to 386	2 to 7	10 to (?)	410	3 to 13	12 to 105

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Aver. days	Number	Number	Number	Days
466	7 to 12	9 to 22	19.7	7,742	2,000	3,536	37 to 154

ECONOMIC IMPORTANCE

A. cajennense is very annoying to animals and to man. In parts of South America it is alleged to cause great damage to cattle by producing "fever," weakness, and death.

This species is a vector of spotted fever in Mexico, Panama, Columbia, and Brazil. Experimentally, this tick is capable of transmitting Chagas' disease, or American trypanosomasis, Q fever, and brucellosis to man.

AMBLYOMMA HEBRAEUM KOCH, Bont Tick

HABITAT

A. hebraeum is a native of Africa. The species thrives in a warm, moderately humid climate on the veld where high bushes provide shade. It is most numerous along the southern and eastern coasts of South Africa, French West Africa, the Congo, Kenya, Mocambique, and Tanganyika.

In September 1962, two dead male ticks of this species were found in the ear of a rhinoceros at a game farm in New York. The animal was a recent import from South Africa. No additional specimens were reported anywhere in the United States until December 1963, when one dead male A. hebraeum was found on a white rhinoceros in a zoological garden in Oklahoma City. This host had arrived in the United States from South Africa in August 1963.

HOSTS

Cattle are the principal hosts. Most warmblooded animals, including the following, may also serve as hosts: Ass, domestic dog, goat, horse, mule, sheep, and man; antelope, black rhinoceros, black wildebeest, blesbuck, elephant, giraffe, springbuck, white rhinoceros, wild dog, and zebra; domestic fowl, ostrich, small game, and vermin.

LOCATION ON HOST

Larvae feed on small animals; nymphs parasitize larger animals. Larvae and nymphs thrive anywhere on the body, even among the thick hairs of Angora goats. Adults attach to the largest available animals, except carnivores.

Adults select bare sites: The groin and axilla and on the genitals; the udder and teats; the underparts of the abdomen and brisket; under the tail; inside the ears; between the claws; and beneath the fetlocks of horses.

LIFE CYCLE

A. hebraeum is a three-host tick.

After attaching to a host, the adult female may engorge and drop replete 7 to 20 days later. Oviposition does not begin until 2 weeks, sometimes as long as 3 months after leaving the host. Ten to twenty thousand eggs may be deposited. Eggs hatch in a minimum period of 70 days or may take 180 days.

LIFE CYCLE (Con.)

Larvae may live 240 days unfed. Upon finding a host, larvae engorge and drop within 4 to 20 days, or an average of 5 to 7 days. Molting may occur in 25 to 120 days.

Unfed nymphs may have a similar longevity of approximately 250 days. Nymphs may engorge in 4 to 20 days and molt in 18 to 160 days. The unfed adult may live up to 450 days.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
240	4 to 20	25 to 120	250	4 to 20	18 to 160

ADULTS				
Longevity (unfed)	Engorgement	Preoviposition	Eggs deposited	Incubation of eggs
Days	Days	Days	Number	Days
210 to 450	7 to 20	14 to 90	10,000 to 20,000	70 to 180

ECONOMIC IMPORTANCE

A. hebraeum is a vector of Rickettsia ruminantium, causative agent of heartwater in cattle, sheep, and goats.

Larvae and nymphs pick up the rickettsiae during feeding on an infected host. The rickettsiae are limited to the epithelial cells and lumen of the tick alimentary tract. There is no transovarial transmission.

The organism is transmitted to succeeding nymphs or adults during metamorphosis. Once infected, nymphs retain the infection even if subsequent feedings are on susceptible, nonsusceptible, or immune animals. A. hebraeum can infect itself with heartwater rickettsiae by feeding on an infected ruminant up to 14 days after the host's recovery.

Due to its habits of almost burying itself in the skin of its host during feeding, the bont tick causes serious abscesses. When these ticks occur on the legs and between the toes of cattle and sheep, they cause sores that result in lameness.

Lesions caused by these ticks are believed to afford entrance to the causative organisms of ulcerative and epizootic lymphangitis of horses.

AMBLYOMMA MACULATUM KOCH, Gulf Coast Tick

HABITAT

In the United States this tick is established in the regions of high temperature, rainfall, and humidity bordering the Atlantic Ocean and the Gulf of Mexico; for the most part within 100 miles of the coast. The "Carolinas" are the type locality. The tick has also been reported in Mexico, Jamaica, and South America.

HOSTS

Larvae and nymphs attack ground-inhabiting birds, with the meadow lark the most important host during fall and winter. Other hosts are fox, jack-rabbit, rat, and squirrel. Adults attack cattle, dog, goat, horse, mule, sheep, and man. Additional hosts for the species are deer and wolf.

LOCATION ON HOST

Larvae and nymphs attach primarily to the head of the host. Adults attach chiefly in the concavity of the outer ear. All stages feed on the hump of Brahman cattle and sometimes along the top of the neck of all breeds.

LIFE CYCLE

A. maculatum is a three-host tick.

Numbers of adults, rearely found on hosts during late winter and spring, increase rapidly from mid-July to early fall.

Adults attach readily to a host, but may delay 12 days before copulating. Once mating occurs, the male remains in coitu until the female engorges and drops. The male then goes in search of another mate. Females apparently do not engorge in the absence of males.

Males remain on the host for several months after all females drop. Having fed, however, males do not live long off the host.

Females may engorge as soon as 5 days, and if dislodged partially fed will complete engorgement on another host. Oviposition may begin 3 days after dropping and continue for 13 to 75 days with a maximum of 18,497 eggs deposited.

Larvae attach to the head of ground-feeding birds and are found at any time of the year. Feeding lasts $2\frac{1}{2}$ to 10 days; molting, a minimum of 7 days.

Nymphs likewise attach to ground-inhabiting birds or to small mammals. Engorgement lasts $4\frac{1}{2}$ to 11 days and molting 17 to 71 days. Nympths that engorge in the fall, however, may not molt until spring.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
179	$2\frac{1}{2}$ to 10	7 to 121	--	$4\frac{1}{2}$ to 11	17 to 71

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Days	Number	Number	Number	Days
411	5 to 18	3 to 9	13 to 75	18,497	4,560	8,282	21 to 142

ECONOMIC IMPORTANCE

This species is not known to transmit disease. It causes "tick-worry" to domestic animals, and massive infestations result in great loss of blood and debilitation.

This tick also causes painful swelling of the ears and creates conditions which encourage screwworm attack.

The toxins injected by the feeding female 5 to 9 days after attachment reportedly produces tick paralysis in man and dogs.

A rickettsia from this tick collected from sick sheep, has produced experimentally in guinea pigs an ailment known as "Maculatum disease."

ARGAS PERSICUS (OKEN), Fowl Tick

HABITAT

The fowl tick is extensively distributed throughout the tropical and temperate regions of the world from sea level to elevations of 6,000 feet. In the United States, it is most prevalent in the Southwest and in Florida.

HOSTS

Chickens are the principal hosts. Other hosts are ducks, geese, and turkeys; a wide variety of land and water birds, such as canaries, quail, wild doves, wild ducks, wild turkeys, and vultures; wild desert rabbits and rodents, occasionally; man, infrequently, and probably only in the absence of fowls.

LOCATION ON HOSTS

Larvae attach beneath the wings and other places where feathers are sparse.

LIFE CYCLE

A. persicus is a multi-host tick.

The adult hides during the day waiting for night and may crawl several yards to find a host. Attachment of the unfed adult female is influenced by the odor of the host and the temperature which makes the host odor attractive. Hot weather favors activity and rapid development of this species. An unfed female adult has remained alive 5 years.

The female can engorge within 20 to 45 minutes. During its lifetime, the female tick may take 7 blood meals a week or more apart and oviposit after each engorgement. Oviposition may begin 3 days after engorgement. On the other hand, cold weather or the absence of males may delay oviposition for weeks or months.

After each blood meal, groups of large, red-brown eggs are laid in sheltered crevices, around poultry houses, and in the bark of trees. A maximum of 274 eggs may be deposited following a single engorgement while toward the last, a minimum of 25 eggs may be laid. The total number of eggs laid is comparatively small. Since A. persicus infests the habitat of the host, withstands prolonged starvation, and is a rapid feeder, many progeny are not necessary for perpetuation of the species.

The minute larva immediately seeks a host. However, it may survive more than 5 months without food. If the host to which the larva attaches is a bird, attachment is usually under or at the base of a wing. The larva feeds by day and night, engorging in 2 to 10 days. Several hours before dropping, the globular-shaped larva flattens into the typical species form. It drops at night, near its host to facilitate re-attachment, and seeks a hiding place. The larva usually molts 4 to 16 days later. The larva is very hardy, having survived submergence in water up to 65 hours.

This species may undergo several nymphal molts. The first instar nymph may live unfed for 9 months. Like the adult, the nymph is a rapid nocturnal feeder. It may engorge within 30 minutes; the longest recorded period is 3 hours. The nymph goes into hiding and molts in 7 to 28 days.

The second instar nymph may live unfed for longer than a year. It attaches to a host at night, feeds, and goes into hiding for another molt. A third instar nymph and an additional molt may follow.

The adult emerges 11 days or longer after the last nymphal molt.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days		Days
30 to 164	2 to 10	4 to 16	180 to 270 253 to 509	30 min. to 3 hours	7 to 28* 11 to 199** 9 to 12***

*1st stage nymph **2nd stage nymph ***3rd stage nymph

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Minutes	Days	Days	Number	Number	Number	Days
1,825	20 to 45	2 to 14	3 to 10	874	47	667	8 to 107

ECONOMIC IMPORTANCE

These ticks inflict extensive skin damage and produce large blood clots on their natural hosts during feeding. Light infestations cause emaciation, weakness, slow growth, and lowered production. Heavy infestations cause exsanguination and death of the host. Turkeys and newly hatched poults and chicks show the greatest mortality. Birds suffer most from these attacks during the warmer, drier seasons of the year.

Toxins injected by the fowl tick cause paralysis in chickens, ducks, and geese.

A. persicus is a vector of fowl piroplasmosis and of the highly pathogenic Borrelia anserina, causative agent of fowl spirochetosis.

Experimental transmissions of anaplasmosis by the fowl tick have been reported.

While this tick is not known to transmit any human diseases, its bite has been reported to cause severe pain, shock, delirium, and even death. Contemporary investigators, however, tend to minimize these long-standing reports.

Experimentally, the plague bacillus, Pasteurella pestis, has survived in the tissues of the fowl tick for varying periods up to 110 days.

BOOPHILUS ANNULATUS (SAY), Cattle Fever Tick

HABITAT

B. annulatus occurs in greatest abundance in tropical and sub-tropical climates. Florida is the type locality. At the beginning of the century the cattle fever tick was widely distributed by cattle movements through the Southern and Western States. The species is now eradicated from the United States except for periodic introductions on clandestine or stray cattle from Mexico where B. annulatus is still prevalent.

This species is also found in tropical west and central Africa, the Sudan, the Mediterranean basin, and the Near East.

HOSTS

The Virginia white-tailed deer is the type host. Cattle are the most frequent hosts. Other hosts are buffalo, donkey, horse, and mule; goat and sheep; African giant eland; deer, infrequently; dog and man, rarely, and probably inadvertently.

LOCATION ON HOST

Larvae prefer the legs, belly, and dewlap. In severe infestations they may be found any place on the body. Nymphs and adults are found on the belly and flanks. Heavy infestations cause widespread distribution on the host.

LIFE CYCLE

B. annulatus is a one-host tick.

Adults crawl from the nymphal skin, males usually preceding females by several days, and attach nearby. After a brief feeding, males seek females and mate, or attach beneath engorged nymphs to await their transformation.

Adult females seldom leave their site of attachment. After mating, females have been observed to engorge in 2 days. More commonly, however, engorgement takes 7 days and may extend to 25 days.

Egg laying may begin the following day, but usually engorged females go through a quiescent preoviposition period varying from several to 98 days. Egg laying may be prolonged 151 days. A female may deposit 5,105 eggs. At a mean temperature of 87^{O} F. eggs hatch in 17 days. At lower temperatures egg hatch may take 202 days. After submergence in water up to 90 hours, 50 percent of engorged adult females have deposited viable eggs.

Emerging larvae climb upon vegetation and attach to a passing host. Larval feeding and molting lasts 5 to 16 days. Larvae have survived water submergence 10 to 157 days. In the absence of a host, larvae have also survived starvation in the winter for 246 days.

When the larval skin splits, the nymph crawls out and reattaches at the same site. Nymphs feed and molt in 5 to 18 days.

The parasitic life span, from larval attachment to female drop, may be completed in less than 20 days. Usually, however, it takes 3 weeks, but may extend to 66 days. When adult female engorgement is completed in 2 days, the same female likely has not completed both larval and nymphal engorgement and molting in minimum periods. The nonparasitic period, from dropping of the engorged female to death of the last larva varies from 28 to 279 days.

LIFE CYCLE SUMMARY

LARVAE		NYMPHS	
Longevity (unfed)	Engorgement and molting	Longevity (unfed)	Engorgement and molting
Days	Days	Days	Days
7 to 246	5 to 16	--	5 to 18

LIFE CYCLE SUMMARY (Con.)

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Days	Number	Number	Number	Days
--	2 to 25	2 to 98	5 to 151	5,105	357	3,424	17 to 202

ECONOMIC IMPORTANCE

B. annulatus is the vector of Babesia bigemina, causal protozoan of cattle fever, or bovine piroplasmosis. The causative organism is transmitted by the female tick via the egg. This disease plagued cattle raisers in the United States for 150 years before the tick was finally eradicated.

This tick has also been incriminated in the transmission of bovine anaplasmosis. Under experimental conditions B. annulatus has transmitted Theileria (Gonderia) mutans, protozoan causative agent of theileriasis in cattle.

Also, experimentally, this species has transmitted via its egg, the spirochete Borrelia theileri, causative agent of relapsing fever in man.

BOOPHILUS MICROPLUS (CANESTRINI), Tropical Cattle Tick

HABITAT

B. microplus is widely distributed through the West Indes, Mexico, Central America, South America, the islands of the Caribbean; and Australia, Africa, and the Oriental Region. At one time the tropical cattle tick was found also in southern Florida.

HOSTS

Domestic cattle are the primary hosts. Other hosts are dog, goat, horse, and sheep; man - rarely; deer; African lion, ocelot, and Indian water buffalo; Kangaroo, pig, wallaby; rabbit (larva only).

LOCATION ON HOST

Larvae feed and molt on the inner surface of the ears. Nymphs and adults are found on the flanks, belly, and udder. All stages may attach, however, on the neck, dewlap, flanks, belly, udder, escutcheon, and scrotum of cattle.

LIFE CYCLE

B. microplus is a one-host tick.

The newly emerged adult male feeds for several hours and then moves about on the host in search of a mate. The adult female, also capable of movement, generally becomes firmly attached while awaiting fertilization. Thereafter, she feeds slowly for the first 5 days, rapidly accelerating during the final feeding stages until engorgement. The male remains in copula, sometimes for several days, until the engorged female drops from the host. Copulation off the host has been noted. The female seeks a sheltered spot to oviposit. The male may remain on the host a month longer moving about fertilizing several females.

Preoviposition, depending upon temperature, may last 2 to 39 days. Deposition of eggs similarly influenced may be completed in 15 days or continue at a low rate for 44 days. Within 14 to 202 days eggs hatch into larvae that are strongly influenced by temperature and humidity and are even more vulnerable than eggs to lowered temperatures. The greatest hatch occurs between 85^{o} to 95^{o} F.

A small percentage of newly emerged larvae wander over the host's body for 2 to 3 days. A very large number, however, bury their mouthparts in the host's skin within an hour of finding a host.

The larva feeds 4 to 19 days. Shortly after its body distends, its legs become rigid and the larva loses its motility. Molting may occur 6 days after attachment. In the free-living state and in the presence of sufficient moisture, the larva may live unfed 184 days.

The young nymph may reattach close to the old larval skin or move to the flanks, belly, or udder for feeding. When full-fed the nymph is immobile. It may molt as soon as 8 days after attachment. Nymphs are frequently found with adults.

The parasitic period of larval attachment to dropping of the engorged adult female ranges from 18 to 38 days but usually is 23 days. In Africa the extreme parasitic period is reported to range from 35 to 149 days.

The non-parasitic period, from dropping of the engorged female to death of the last larva, varies from 89 to 251 days.

The complete life cycle, including parasitic and nonparasitic development, may be completed within 41 to 300 days.

LIFE CYCLE SUMMARY

LARVAE		NYMPHS	
Longevity (unfed)	Engorgement and molting	Longevity (unfed)	Engorgement and molting
Days	Days	Days	Days
65 to 184	4 to 19	--	8 to 13

LIFE CYCLE SUMMARY (Con.)

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Days	Number	Number	Number	Days
--	7 to 13	2 to 39	15 to 44	4,459	1,529	3,424	14 to 202

ECONOMIC IMPORTANCE

In those areas of the world where it is prevalent, B. microplus is a pest of considerable importance.

Among cattle this tick is a vector of Babesia bigemina, a protozoan of red blood cells that causes cattle fever or bovine piroplasmosis; babesia berbera, causative parasite of European cattle piroplasmosis; Anaplasma marginale, causative agent of bovine anaplasmosis; Theileria (Gonderia) mutans, the protozoan parasite that causes theileriasis.

Among sheep, this tick transmits Babesia ovis, cause of ovine piroplasmosis.

Among horses, B. microplus is said to be a vector of Babesia (Nuttallia) equi, causative agent of equine piroplasmosis.

DERMACENTOR ALBIPICTUS (PACKARD), Winter Tick

HABITAT

This tick is widely but unevenly distributed in the northern tier of States from Maine to Oregon and throughout the Western States south into Texas. It is also reported common and widespread in Canada. It is most numerous in the woods and shrubs of upland and mountain country.

HOSTS

The type host is the moose. Preferential hosts are horse, moose, and elk. D. albipictus is also found on cattle, antelope, bear, beaver, bighorn sheep, bison, caribou, coyote, deer, mountain goat, and mountain sheep.

LOCATION ON HOST

When numerous, all stages of this tick attach anywhere on the body. When not numerous, they occur mostly along the belly and between the legs.

LIFE CYCLE

D. albipictus is a one-host tick.

Adults emerge from nymphal skins on the host in late fall, winter, or early spring. Males emerge several hours to a day before the females. The proportion of males to females is approximately 1 to 3. Newly emerged adults are pale with indistinct white markings. After exploratory wandering and several trial attachments, final engorgement may be completed in 8 days. Engorged females are olive-green in color dorsally and slate colored ventrally.

Females copulate at any stage of engorgement on or after the 4th day following molting. Several short matings may occur.

Adults, as well as nymphs, have the ability when accidentally removed to reattach to other hosts for completion of engorgement.

After dropping, females pass a preoviposition period which may be 7 days, but usually is 150 to 180 days. Depending upon temperature and humidity, females deposit 1,455 to 4,411 eggs within 19 to 42 days. Females die within 1 to 30 days after completion of oviposition. Eggs hatch within 33 to 71 days or longer in cool areas.

Larvae move a short distance from the egg mass and form a dense cluster. Moisture is the most important single factor in tick longevity. Clustering of the larvae prevents dessication and increases longevity. Larvae remain inactive throughout the summer, making no attempt to find a host until late fall or winter. Unfed larvae may live 346 days. After attachment, larvae feed and molt in 9 to 20 days.

Nymphs crawl backward out of the larval skin and reattach nearby. A period of wandering and several attachments occur before noticeable engorgement.

The usual period from larval molt to nymphal molt is 9 to 12 days.

Some unfed nymphs that molt from previously detached larvae will reattach and engorge if given an opportunity.

Nymphs also are easily detached, and the molt to adults may take place on the ground. Nymphs that are less than one-half engorged when detached invariably die. The period from dropping of the engorged female to the death of the last larva, or the nonparasitic period, ranges from 159 to 503 days.

LIFE CYCLE SUMMARY

LARVAE		NYMPHS	
Longevity (unfed)	Engorgement and molting	Longevity (unfed)	Engorgement and molting
Days	Days	Days	Days
50 to 346	9 to 20	2 to 77	10 to 76

LIFE CYCLE SUMMARY (Con.)

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Days	Number	Number	Number	Days
2 to 182	8 to 30	7 to 180	19 to 42	4,411	1,455	2,500	33 to 71

ECONOMIC IMPORTANCE

Not all horses and cattle are equally susceptible to attack by the winter tick. Resistance appears to be due to an ability to form scabs at the point of attachment thus healing the wound and throwing off the tick with the scab.

Since this species is most abundant during fall and winter, infestations in the long winter coat of the host are frequently overlooked.

These ticks cause loss of appetite, depression, and debilitation. The loss of blood from heavy infestations weakens and kills horses. Heavy infestations also may cause an edematous condition known as "water belly."

Gross infestations and feed shortages in late winter combine to kill moose and elk. D. albipictus is also a vector of the bacillus, Klebsiella paralytica, that causes paralysis in moose. D. albipictus is a vector of anaplasmosis and a possible vector of Rocky Mountain spotted fever. Experimentally, D. albipictus has demonstrated the hereditary transmission of Corynebacterium ovis, causative agent of caseous lymphadenitis.

DERMACENTOR NITENS NEUMANN SYN. ANOCENTOR NITENS (NEUMANN) [DERMACENTOR (ANOCENTOR) NITENS]
Tropical Horse Tick

HABITAT

The tropical horse tick is found in Florida and the southern tip of Texas; in Mexico, Central America, and the islands of the Caribbean; and in Columbia and Argentina. Jamaica and Santo Domingo are the type localities for the species.

HOSTS

Horse, mule, and ass are preferred hosts of the tropical horse tick. The species is also found on goat and sheep; ox, bull, and calf; deer.

LOCATION ON HOST

This species is unusual because all stages of its development frequently occur in the ears of its host.

On the horse, mule, and ass the preferred site of attachment for larvae, nymphs, and adults is within the ear. They may be found, however, in the nasal diverticula, on the mane and belly, in the anal and inguinal regions, and in heavy infestations on practically any part of the body. On the goat and sheep the larvae prefer the ears. In the bovine the tick prefers attachment within the ear.

LIFE CYCLE

D. nitens is a one-host tick.

Transition from larva to adult generally occurs in the ear of a single host. Adults copulate 2 days after molting. Adult females engorge and drop within 9 to 23 days. Males and females remain in coitu until the female drops. Females oviposit within 3 to 15 days at 85° F. Oviposition lasts 15 to 37 days. An average of 2,784 eggs (maximum 5,460) are laid. Eggs hatch in 19 to 39 days.

Males, from larva to adult, may remain attached to the host up to 99 days.

Under the most favorable natural conditions unfed larvae do not live beyond 71 days. Under laboratory conditions they live up to 117 days. Larvae engorge and molt on the host as early as 8 days after attachment.

Nymphs engorge and begin to molt in 7 days. Both molts occur on the host. The period from larval attachment to dropping of replete females may occur in 24 days. Under laboratory conditions the life cycle has been completed in 80 days.

LIFE CYCLE SUMMARY

LARVAE		NYMPHS	
Longevity (unfed)	Engorgement and molting	Longevity (unfed)	Engorgement and molting
Days	Days	Days	Days
71 to 117	8 to 16	--	7 to 29

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Days	Number	Number	Number	Days
--	9 to 23	3 to 15	15 to 37	5,460	2,149	2,784	19 to 39

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ECONOMIC IMPORTANCE

D. nitens is a vector of equine piroplasmosis. During engorgement the female tick voids large quantities of excrement in which males become embedded and often perish. This causes suppuration and predisposes to screwworm attack. Animals with heavy infestations in the ears are head-shy and intractable.

DERMACENTOR OCCIDENTALIS MARX, Pacific Coast Tick

HABITAT

This is the most common tick in the Pacific coast region. It is found in the narrow land strip between the Sierra Nevada Mountains and the Pacific Ocean from Oregon to southern California. The type locality is Occidental, Calif.

This species is closely related to D. venustus (= andersoni) with which it has been hybridized experimentally.

HOSTS

Deer are the type host for this species. Other hosts for the adult tick are cow, dog, donkey, horse, mule, mule deer, rabbit, sheep, and man.

Adult ticks are found on these hosts throughout the year reaching a peak in April and May.

Immature ticks have been reported on 26 different species of host. Among them are chickares, chipmunk, coyote, ground-squirrel, lizard, mice, rabbit, skunk, and wood rat.

Immature forms are most abundant in spring and summer.

LOCATION ON HOST

All stages of the tick are distributed generally over the host's body.

LIFE CYCLE

D. occidentalis is a three-host tick.

Mating takes place on the host 1 to 3 days after attachment. Engorgement of females can be completed without fertilization, but no eggs will be deposited.

The shortest period for female engorgement is 6 days. After dropping, oviposition may begin in 4 days and last 27 to 39 days.

A maximum of 4,555 eggs are deposited. Unfed female adults can live 359 days, males not quite so long. Eggs may hatch as soon as 16 days after deposition, but more normally in 21 to 38 days.

The larva begins to engorge several hours after attachment to a host. It completes feeding within 3 to 7 days and drops from the host. Molting occurs in a minimum of 6 days.

With a host available, the nymph attaches immediately. Engorgement is completed in a minimum of 3 days and the nymph leaves the host. Molting takes place in 13 to 23 days. Approximately equal numbers of adult males and females emerge.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorge-ment	Molting	Longevity (unfed)	Engorge-ment	Molting
Days	Days	Days	Days	Days	Days
24 to 124	3 to 7	6 to 12	40 to 108	3 to 9	13 to 23

ADULTS							
Longevity (unfed)	Engorge-ment	Preovi-position	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Days	Number	Number	Number	Days
359	6 to 17	4 to 17	27 to 39	4,555	--	3,210	16 to 38

ECONOMIC IMPORTANCE

D. occidentalis is a reported vector of bovine anaplasmosis.

Toxins injected by the tick cause paralysis in cattle. In its habitat this is reportedly the most common tick to attack man. Its bite causes local inflammation. It is believed to transmit tularemia to humans.

This species is a carrier of the Colorado tick fever virus and is found naturally infected with the rickettsia of Q fever. Experimentally it is an effective carrier of Rocky Mountain spotted fever.

DERMACENTOR VARIABILIS (SAY), American Dog Tick

HABITAT

This tick is widely distributed over the eastern two-thirds of the United States from Nova Scotia to the Gulf Coast. It is also common in California and Oregon. It has been recorded from Laborador, Ontario, and the Republic of Mexico. In July 1963, D. variabilis was reported on dogs in quarantine in Hawaii. High humidity and a reservoir of wild rodents for the immature stages favor the distribution and abundance of the tick.

HOSTS

The immature stages engorge mainly on small rodents, particularly meadow mice.

The dog is the preferred host for the adult tick. Other hosts are cat, cattle, donkey, hog, horse, mule, sheep, and man; coyote, deer, fox, peccary, and wolf; civet, leopard-cat, Mexican lion, wildcat; badger, opossum, rabbit, raccoon, rat, skunk, squirrel, weasel, and woodchuck.

LOCATION ON HOST

Larvae attach mainly around the head although they will also feed on the neck and shoulders of small mammals.

LIFE CYCLE

D. variabilis is a three-host tick.

In the Central and Northern States adult activity begins in mid-April, peaks in June, and thereafter declines until September. In the Southern States, ticks in all stages may be found on hosts throughout the year; adults, while present, are less numerous in the winter.

Adult ticks cling to vegetation and await the arrival of a host. After attachment, adults feed for several days and then mate. Mating lasts a day or two. Females may engorge in 5 days, but the average is 10.5 days. After mating and engorging, females detach and fall to the ground. Males feed and mate a number of times. Unfed adult females may survive 2 to 3 years. The preoviposition periods varies from 3 to 58 days. Between 2,808 and 7,378 eggs are laid in 14 to 32 days. Eggs usually hatch in 20 to 57 days. The longest incubation period recorded with over-wintering eggs was 303 days; however, resultant larvae were abnormal.

Upon hatching, larvae remain close to the soil and mice runs. Over-wintering unfed larvae become active toward the end of March, and activity continues until the end of July. Though the immature stages are found on hosts nearly the year round, they are more active in warm than in cool weather and survive long periods submerged in water. Unfed larvae may live up to 540 days. Larvae feed on mice and other small mammals for 2 to 13 days. When fully fed, the larvae drop and seek a concealed niche for molting. The period from larval drop to molt varies from 6 to 247 days.

Newly-emerged nymphs may survive 29 to 584 days without feeding. Nymphal activity begins at the end of March and continues until early September. Nymphs attach to small mammals and feed for 3 to 12 days. They then drop to the ground and molt within 16 to 291 days. Duration of these phases is largely dependent upon temperature and humiditiy. Seasonal activity is also influenced by the amount of daylight and north-south geographical distribution of the tick.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
14 to 540	2 to 13	6 to 247	29 to 584	3 to 12	16 to 291

LIFE CYCLE SUMMARY (Con.)

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Aver.	
Days	Days	Days	Days	Number	Number	Number	Days
1,053	5 to 27	3 to 58	14 to 32	7,378	2,808	4,776	20 to 57

ECONOMIC IMPORTANCE

This tick causes annoyance to domestic animals but is not a known vector of any animal disease. Experimentally, it has transmitted anaplasmosis of cattle.

D. variabilis is a common pest of dogs which may be parasitized to emaciation or paralyzed from toxins injected by the tick. This tick transmits Rocky Mountain spotted fever to dogs and is also a vector of the bacteria, Babesia canis, causative agent of piroplasmosis in dogs.

D. variabilis transmits tularemia to rabbits.

D. variabilis is the principal vector of Rocky Mountain spotted fever to man from the Mississippi Valley east to the Atlantic and south to the Gulf of Mexico, including Texas. Under laboratory conditions, this tick has transmitted the St. Louis strain of Japanese type B encephalitis. The virus of Colorado tick fever has been isolated from D. variabilis on Long Island. The toxins injected by this tick have also produced paralysis in man.

DERMACENTOR VENUSTUS BANKS SYN. DERMACENTOR ANDERSONI STILES
[DERMACENTOR VENUSTUS (= ANDERSONI)] Rocky Mountain Wood Tick

HABITAT

This tick occurs from British Columbia, Alberta, and Saskatchewan south in a wide swath through the Rocky Mountains to New Mexico and California. The development of D. venustus (= andersoni) is favored by moisture and protection from direct sunlight in cut-over brushy areas. The type locality is Texas.

HOSTS

Larvae and nymphs are found on 36 species of hosts including squirrel, woodchuck, chipmunk, rabbit, rat, mouse, and pocket gopher.

Adults are frequently found on the large domestic animals such as horses and cattle. Other hosts are ass, cat, dog, goat, hog, mule, sheep, and man; brown bear, coyote, deer, mountain goat, porcupine, and wood chuck; occasionally badger, rabbit, and wildcat.

LOCATION ON HOST

Larvae attach most frequently around the head and ears. They are also found between the shoulders.

Adults attach principally between the legs and axillae, on the escutcheon, belly, and dewlap, and occasionally on the shoulders. On horses, they attach under the jaws and in the mane. In British Columbia, adults are nearly always found on the poll or on the shoulders.

LIFE CYCLE

D. venustus (= andersoni) is a three-host tick. It usually has a 2-year life cycle, but may require 3 years.

Beginning in early March unengorged adults emerge from hibernation and crawl upon vegetation to await a host. Reluctance of adults to attach at any time except in the spring seems to be a fixed behavior pattern. Likewise, newly molted adults do not attach until completion of a resting period that may vary from weeks to months. Directly after molting and for several days, both sexes reduce their size considerably by voiding white pellets of excrement.

The male feeds for 4 to 8 days and then seeks a mate. A male may remain on a host 2 months and mate with a number of females.

The female engorges in 4 to 17 days. Immediately upon leaving the host the female seeks a sheltered place for oviposition. This may begin in 3 to 5 days and a maximum of 7,396 eggs may be laid in a period of 15 to 32 days. The size of the female determines the number of eggs deposited. Females only one-fourth engorged have deposited fertile eggs. Eggs hatch in 15 to 73 days.

Larval development within the egg begins immediately upon deposition. The appearance 2 weeks later of a white spot on one side of the egg indicates viability. Larvae may emerge in 15 days. If they are successful in finding a small wild mammal host, they usually attach about the head or ears. Engorgement takes 2 to 8 days.

Nymphs begin to emerge from the larval molt in mid-July. They may remain quiescent until cool weather, go into winter hibernation, and appear as unengorged nymphs the following July; or, nymphs may quickly attach to small wild mammals, complete engorgement, and drop in 4 days. After an active period of several days to weeks on the ground, they then become quiescent. Molting can be completed in 11 days, in which case the new adults overwinter in the unfed state.

Prior to adult emergency, drops of a yellow exudate appear on the body surface of the nymph. Sexes are distinguishable several days before adult emergence.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
30 to 317	2 to 8	6 to 31	376	3 to 11	11 to 170

LIFE CYCLE SUMMARY (Con.)

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Aver.	
Days	Days	Days	Days	Number	Number	Number	Days
641	4 to 17	3 to 59	15 to 32	7,396	2,496	5,422	15 to 73

ECONOMIC IMPORTANCE

This tick is annoying to domestic and wild animals. Toxins from the bite of the female tick may paralyze and ultimately kill cattle, sheep, goat, horse, cat, dog, pig, hamster, guinea pig, bison, and man.

D. venustus (= andersoni) is a vector of the bacillus, Salmonella enteritidus, which causes a paratyphoid like disease in rodents.

This species also transmits bovine anaplasmosis, maintaining the infection from one generation to another via the egg. Experimentally, this tick has transmitted equine encephalitis.

D. venustus (= andersoni) also carries the protozoan causative agent of canine piroplasmosis.

This tick is a prime vector of Rickettsia rickettsii, causal agent of Rocky Mountain spotted fever. The infection is maintained in ticks from generation to generation by transmission through the egg. Infection is enhanced by transmission via semen from infected male ticks to clean females.

D. venustus (= andersoni) is an important vector of Colorado tick fever of man, tularemia, and the western variety of Japanese type B encephalitis.

This tick carries natural infections of the rickettsia, Coxiella burnetii, and may be a vector of Q fever to man. More probably, this tick plays an important, indirect roll in the natural history of the disease. Evidence indicates that man acquires the infection by inhalation of the rickettsiae in contaminated tick feces or in hair and wool.

HAEMAPHYSALIS LEPORISPALUSTRIS (PACKARD), Rabbit Tick

HABITAT

The rabbit tick is widely distributed throughout continental United States from Massachusetts to California and from Alaska to South America.

HOSTS

Hares and rabbits are the preferred hosts of the adult tick although all stages also occur on these hosts. Other much less frequent hosts are cat and dog; ground-hog, opossum, and small rodents; meadow lark, quail, and robin.

Immature forms often attach to ground-feeding game birds such as grouse, quail, and meadow lark, and to a large variety of migratory birds.

LOCATION ON HOST

On rabbits, adult ticks usually attach to the ears, around the eyes, and about the head; occasionally they are found on the body and between the toes. On birds, immature ticks usually attach around the eyes and ears and on the head and neck.

LIFE CYCLE

H. leporispalustris is a three-host tick.

In warm climates all stages of the tick are active throughout the year. The rabbit tick has adapted its life cycle to the nocturnal habits of its host. The engorged female, which completes feeding in a minimum of 17 days, does not detach from the rabbit or hare during its nighttime wandering, but leaves the host during the day--particularly in the afternoon, when the host is inactive in its resting place. The mechanism that causes the engorged female to drop from the host in the afternoon seems to be associated with some cyclic physiological change in the host rather than in the tick.

The female tick is comparatively small and deposits relatively few eggs. As few as 59 to a maximum of 2,400 eggs are deposited. Females usually die the day following completion of oviposition.

Eggs hatch in a minimum of 22 days and the larvae have ready access to the rabbits or to ground-feeding birds.

Larvae engorge in 4 to 10 days and drop from the host. Molting occurs in 18 to 134 days.

Nymphs attach to the same or a different host and complete feeding in 4 to 8 days. They drop and molt in 13 to 124 days. Both sexes have approximately the same nymphal molting periods. Even when engorged nymphs drop in the winter, a very large percentage survive to adulthood.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
40 to 258	4 to 10	18 to 134	342	4 to 8	13 to 124

LIFE CYCLE SUMMARY (Con.)

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Aver.	
Days	Days	Days	Days	Number	Number	Number	Days
17 to 588	17 to 35	2 to 18	3 to 57	2,400	59	1,517	22 to 61

ECONOMIC IMPORTANCE

H. leporispalustris does not ordinarily attack domestic animals and is not known to attack man. However, gross infestations weaken and kill rabbits and birds. This tick transmits tularemia and Rocky Mountain spotted fever to rabbits and other susceptible animals to which it attaches.

H. leporispalustris is a carrier of the rickettsia, Coxiella burnetii, causative agent of Q fever.

IXODES SCAPULARIS SAY, Black-legged Tick

HABITAT

This tick congregates along paths, trails, and roadways. It is found from southern Massachusetts to Florida, and from Iowa and Indiana to Louisiana, Texas, and Mexico.

HOSTS

Both adults and immature forms are general feeders on mammals. These include cattle, dog, goat, hog, horse, sheep, and man; deer, fox, lynx, oppossum, and squirrel.

Immature stages are also found on bluejay; lizards; quail; small mammals, including field mice and rats; and thrush.

LOCATION ON HOST

Adults are found usually on the head and neck of dogs and larger mammals.

LIFE CYCLE

I. scapularis is a three-host tick.

Adult ticks are in greatest abundance in late winter and early spring. Mating may take place off the host, but usually occurs on the host 2 days after the ticks attach. Engorged females commence egg laying 15 to 19 days after dropping from the host. Three thousand or more eggs are laid. Some egg hatching may begin in 72 hours, but the complete incubation period lasts 48 to 135 days.

LIFE CYCLE (Con.)

Larvae can remain alive and unfed 75 days and then attach to a host. Larvae engorge in 3 to 9 days and molt 23 to 31 days later.

Upon reattachment to a new host, nymphs engorge in 3 to 8 days and at high summer temperatures molt in 25 days.

High relative humidity and moderate temperature are required for the development of this tick. Under optimum laboratory conditions the complete life cycle averages 132 days. Under natural conditions, however, one generation a year probably is normal.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
75	3 to 9	23 to 31	60	3 to 8	25 to 56

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Aver.	
Days	Days	Days	Days	Number	Number	Number	Days
--	7 to 9	15 to 19	--	3,000	3,000	3,000	48 to 135

ECONOMIC IMPORTANCE

Because of its long mouthparts, this tick is an annoying parasite of dogs, cattle, sheep, and man.

It is not a known vector of any disease although experimentally it has transmitted bovine anaplasmosis.

I. scapularis is an experimental vector of tularemia and has been found infected in nature.

OTOBIUS MEGNINI (DUGÈS), Spinose Ear Tick

HABITAT

This tick is a native of the Americas. The original specimens were found in the ears of Mexican horses. The spinose ear tick has been dispersed to many localities in the ears of its host. It is found in South America, South Africa, India, and Hawaii. It has also been reported in British Columbia. In general, O. megnini is restricted to areas of low humidity and is probably most abundant in the southwestern United States and Mexico.

The spinose ear tick derives its name from the bristly body of the nymph and from its habit of infesting the ears.

HOSTS

Larvae and nymphs are found on cat, cattle, dog, donkey, goat, hog, horse, mule, sheep, and man; black-tailed deer, coyote, deer, elk, mountain goat, ostrich, and rabbit.

LOCATION ON HOST

Larvae and nymphs attach deep in the ears. Adults do not feed and are found off the host.

LIFE CYCLE

O. megnini is a one-host tick.

The larva crawls over fence posts, trees, and upon vegetation. It attaches to a passing animal and makes its way to the ears. The larva may engorge in 7 days. It molts within 7 to 12 days into the characteristic spiny-skin nymph. It is not known whether this first instar nymph feeds before it molts.

The second nymph attaches in the same region and feeds slowly for 4 weeks to 7 months. Upon completion of engorgement, the nymph drops out of the host's ear and crawls until it encounters a feed trough, post, or tree upon which it climbs upward several feed to find a protected, dry crack or crevice. Nymphs may molt as soon as 6 days after dropping.

The second-instar nymph molts within a few days. This third molt produces the adult. Fertilization must precede oviposition. Adults mate within a day or two and females begin oviposition within 7 to 42 days after the nymphs leave the ear of the host. Females may cease oviposition for 83 days and then recommence. Oviposition may last approximately 180 days. Eggs hatch within 10 to 23 days.

This tick has developed two adaptations to the arid conditions of the Southwest to ensure perpetuation of the species.

1. The adult remains in hiding and does not feed. Nymphal engorgement satisfies the requirements for adult development and oviposition.
2. Small batches of eggs are deposited at intervals extending over more than 6 months.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
19 to 100	7 to 210	7 to 12	--	31 to 209	6 to (?)

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Days	Number	Number	Number	Days
940	--	7 to 42	14 to 180	1,546	358	814	10 to 23

ECONOMIC IMPORTANCE

This species is a serious pest of cattle and horses. By attaching deep in the ears, it causes considerable irritation and pain. The injury predisposes to screwworm attack which may lead to disfigurement or death. Secondary infection may cause perforation of the ear drum and invasion of the middle and inner ear. In some instances this leads to nerve destruction and cerebral derangement or death due to meningitis.

Although found on hosts throughout the year, the injurious effects produced by this tick are especially noticeable. The greatest death losses among range cattle occur in winter and spring particularly when animals are in poor condition following drought. While this tick is not known to cause any disease, it carries natural infections of the causative rickettsia of Q fever.

Toxins injected by the spinose ear tick may cause paralysis in cattle.

Infestations in man, although rare, cause severe pain.

RHIPICEPHALUS EVERTSI NEUMANN, Red Tick

HABITAT

R. evertsi, a highly adaptable African species, is found widely distributed in all types of forest and grassland, coastal areas and plains from the Sudan to South Africa. Although this tick also occurs in the deserts of north Kenya and in the semi-deserts of the Sudan, its distribution is limited more by rainfall below 10 to 15 inches than by altitude or low temperature. The activities of this species apparently are not limited by seasonal variations.

HABITAT (Con.)

In 1960, the red tick was found on a variety of wild animals confined to two compounds in Florida and on a game farm in New York. From the number of ticks and the variety of animals found infested it was conceivable that this species had been in the wild animal compounds of Florida for several years. R. evertsi was declared eradicated from the premises in Florida and in New York in January 1962.

HOSTS

The horse, mule, donkey, and zebra are preferred hosts. All stages of the tick, however, also infest the following wild and domestic animals: Abysinian ass, antelope, eland, giraffe, nigai, warthog, and zehorse; camel, cattle, dog, goat, pig, and sheep. Immature stages of the tick will sometimes attack baboon, cane rat, hare, and shrew.

LOCATION ON HOST

Larvae and nymphs generally cluster deep in the convolutions of the ear canal; more rarely on the flanks.

Adults generally attach between the hind legs, on the tests, on the scrotum, and in the perianal area often hidden in the skin folds or on the mucous membrane of the anus. Ocassionally, they are found in the penis sheath of equines.

LIFE CYCLE

R. evertsi is a two-host tick. Mating takes place on the host. The female tick engorges in 6 to 10 days and drops from the host. If this occurs on hard ground with sparse cover, the tick will crawl as far as 39 feet to find a suitable site to oviposit. A period of preoviposition may last 6 to 24 days. The male tick spends its entire life span of several months on the host.

Eggs are laid in a cluster of several hundred to several thousand. Eggs have remained viable after submersion in water for 80 days.

Oviposition to hatching lasts 28 to 70 days. After hatching, larvae remain on the ground in a cluster for a variable period of 4 to almost 20 days. They then climb upon vegetation and spend short periods moving about on stems and leaves, alternating with longer periods of rest in a cluster on the underside of a leaf or in a leaf-stem axilla. Unfed larvae remain on upper vegetation up to 175 days. The ground temperature and humidity of a deep grass environment is more favorable to larval development than that of a short grass area.

Overwintering may occur either in the egg or the larval stage. The unfed larva can survive 7 months.

The larva attaches to a host, feeds, and, while still attached, molts to the nymph. The nymph feeds on the same host and when replete drops to the ground to molt. Combined larval feeding and molting and nymphal feeding takes 10 to 15 days.

The nymphal pre-molting period on the ground lasts 42 to 56 days. Molting may take 20 to 30 days.

The adult seeks a new host.

LIFE CYCLE SUMMARY

LARVAE				NYMPHS		
Longevity (unfed)	Pre-attachment	Preattachment on vegetation	Larval feeding and molting and nymphal feeding	Longevity (unfed)	Premolting on ground	Molting
Days	Days	Days	Days	Days	Days	Days
210	4 to 20	(?) to 175	10 to 15	--	42 to 56	20 to 30

ADULTS				
Longevity (unfed)	Engorgement	Preoviposition	Oviposition to hatching	Eggs deposited
Days	Days	Days	Days	Number
420	6 to 10	6 to 24	28 to 70	300 to 3,000

ECONOMIC IMPORTANCE

R. evertsi is a vector of bovine piroplasmosis and anaplasmosis. It also transmits East Coast fever and pseudo-East Coast fever. The red tick likewise is a vector of the spirochete, Borellia theileria, causative agent of spirochetosis in cattle, goats, and sheep.

This tick is reported to transmit equine piroplasmosis and spirochetosis in horses, mules, and donkeys.

The red tick is a reported carrier of Gonderia, causative microorganisms of gonderiasis in sheep and goats. Toxins injected by the tick can cause paralysis in cattle and sheep. Infestations of larvae and nymphs in the ears predispose to bacterial infection, otitis, and sloughing of the external ear. The larva of this species is reported to be the most common vector of tick bite fever in the bush areas of South Africa.

R. evertsi also is a vector of Rickettsia ovina, causative organism of benign ovine rickettsiosis.

RHIPICEPHALUS SANGUINEUS (LATREILLE), Brown Dog Tick

HABITAT

The brown dog tick is believed to be a native African tick whose preference for domestic dogs and possibly for birds has facilitated its spread throughout the warmer parts of the world. The tick was first described in France. With the possible exception of Argas persicus, the fowl tick, Rhipicephalus sanguineus is probably the most widely distributed tick species in the world. In certain areas of the world physiological races of this tick may have developed with adaptation to particular hosts. This species has developed strains resistant to ixodicidal control.

HOSTS

R. sanguineus attaches principally to dogs, on whom, in the United States, it is predominantly limited. In other parts of the world this species has been reported on buffalo, camel, cat, cattle, deer, donkey, dromedary, goat, horse, mule, and sheep; baboon, fox, lion, and zebra; ground-feeding birds (bustard, buzzard, eagle, hawk, hornbill, ibis, kite, ostrich, owl, pigeon, secretary bird, stork); bat, hare, hedgehog, rabbit, reptiles, and man.

LOCATION ON HOST

Larvae attach mostly in hairy places--nymphs anywhere--on the body of domestic animals. Adults are frequently found on and in the ears, though they may attach along the nape, between the toes, or on any other part of the body.

On the dog, immature stages attach to the neck. Adults frequently attach inside the ears and between the toes. All three stages, however, may attach to any part of the body.

On birds, ticks are found on the crown or around the ears, eyes, or bill.

LIFE CYCLE

R. sanguineus is a three-host tick. Adults mate on the host as early as 4 days after attachment. Females engorge in 6 to 50 days, fertilization hastening engorgement.

Oviposition begins on the third day after the female leaves the host, and within 21 to 29 days, 4,000 to 5,000 eggs may be deposited. Females oviposit under stones or straw--or between boards, under plaster, or in crevices in walls as high as 15 feet above ground.

Eggs hatch in 19 days. Immersed in water, eggs have hatched in 51 days. Large numbers of eggs deposited daily and the short period required for oviposition during warm weather are characteristics of the species.

Larvae collect near the bottom of walls and may live 253 days while awaiting a host. Even immersed in spring water, larvae can survive 30 to 35 days. Once attached, larvae may engorge in 3 days. Molting may occur in a minimum of 6 days.

Nymphs are less hardy than larvae; few live longer than 97 days although a maximum of 183 days has been recorded. Engorgement may occur in 4 days; molting in 12. Newly emerged adults may live unfed 568 days. Under favorable conditions the life cycle may be completed in 63 days. Variations in the length of the life cycle are due to climatic factors affecting oviposition, hatching, and pre-molting periods; the duration of feeding times is similar in all seasons.

LIFE CYCLE SUMMARY

LARVAE			NYMPHS		
Longevity (unfed)	Engorgement	Molting	Longevity (unfed)	Engorgement	Molting
Days	Days	Days	Days	Days	Days
24 to 253	3 to 7	6 to 29	75 to 183	4 to 9	12 to 129

LIFE CYCLE SUMMARY (Cont.)

ADULTS							
Longevity (unfed)	Engorgement	Preoviposition	Oviposition	Eggs deposited			Incubation of eggs
				Max.	Min.	Average	
Days	Days	Days	Days	Number	Number	Number	Days
158 to 568	6 to 50	3 to 83	8 to 67	5,000	360	1,602	19 to 142

ECONOMIC IMPORTANCE

The brown dog tick is an exceedingly troublesome pest of dogs causing discomfort, blood loss, and disease. It is also a vector of Rickettsia canis, causative agent of canine rickettsiosis, and of Babesia canis, the protozoon that causes piroplasmosis or malignant jaundice in dogs.

R. sanguineus is an intermediate host of Hepatozoon canis which causes infection and anemia when dogs swallow the tick. Toxins injected by ticks can cause paralysis in dogs.

It is also believed that the brown dog tick transmits Salmonella enteritidis, which causes a paratyphoid disease in dogs and in laboratory animals.

R. sanguineus is a vector of Borrelia theileri, causative agent of spirochetosis in sheep, goats, horses, and cattle.

The brown dog tick is also incriminated in the spread of encephalitis in horses and in the experimental transmission of anaplasmosis and piroplasmosis in cattle.

This tick carries natural infections of Q fever and experimental transmission to man has been demonstrated.

In man R. sanguineus is a vector of Rocky Mountain spotted fever, tularemia, and boutonneuse (or Marseilles) fever. Experimentally, this tick is capable of transmitting Chagas' disease or American trypanosomiasis. The brown dog tick is not considered important in the transmission of human disease in the United States.

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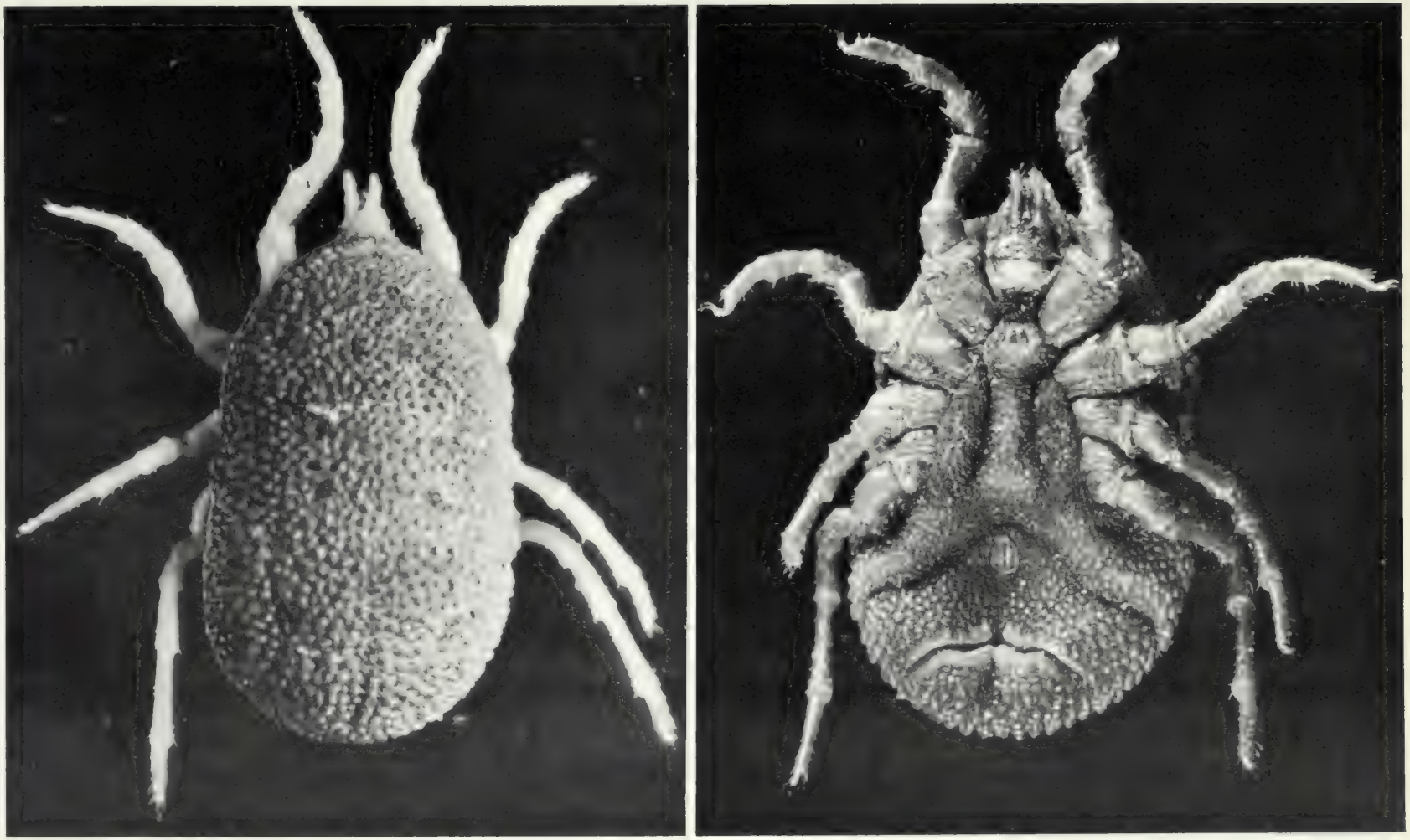


Dorsal MALE Ventral

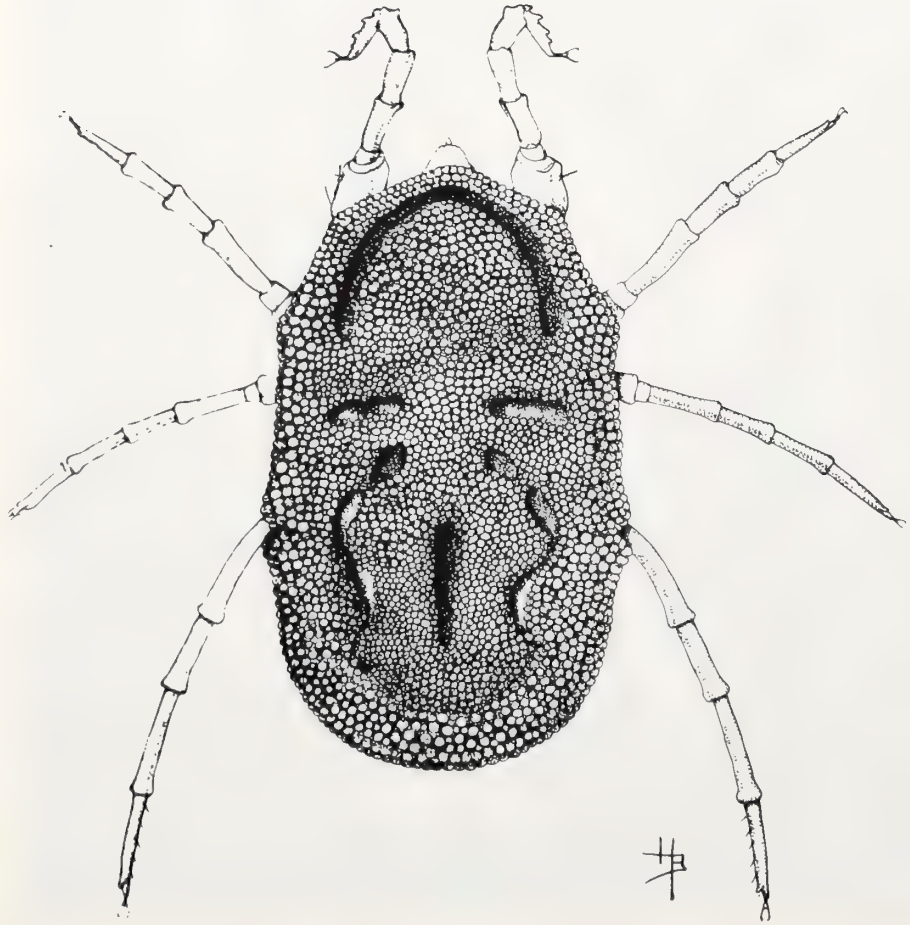
Ornithodoros turicata

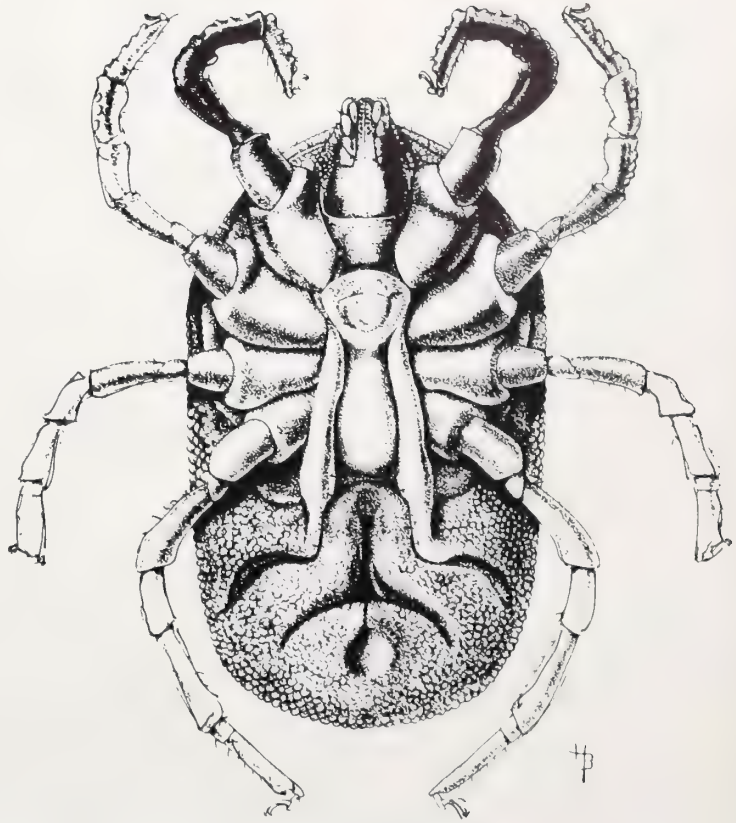
Ornithodoros turicata

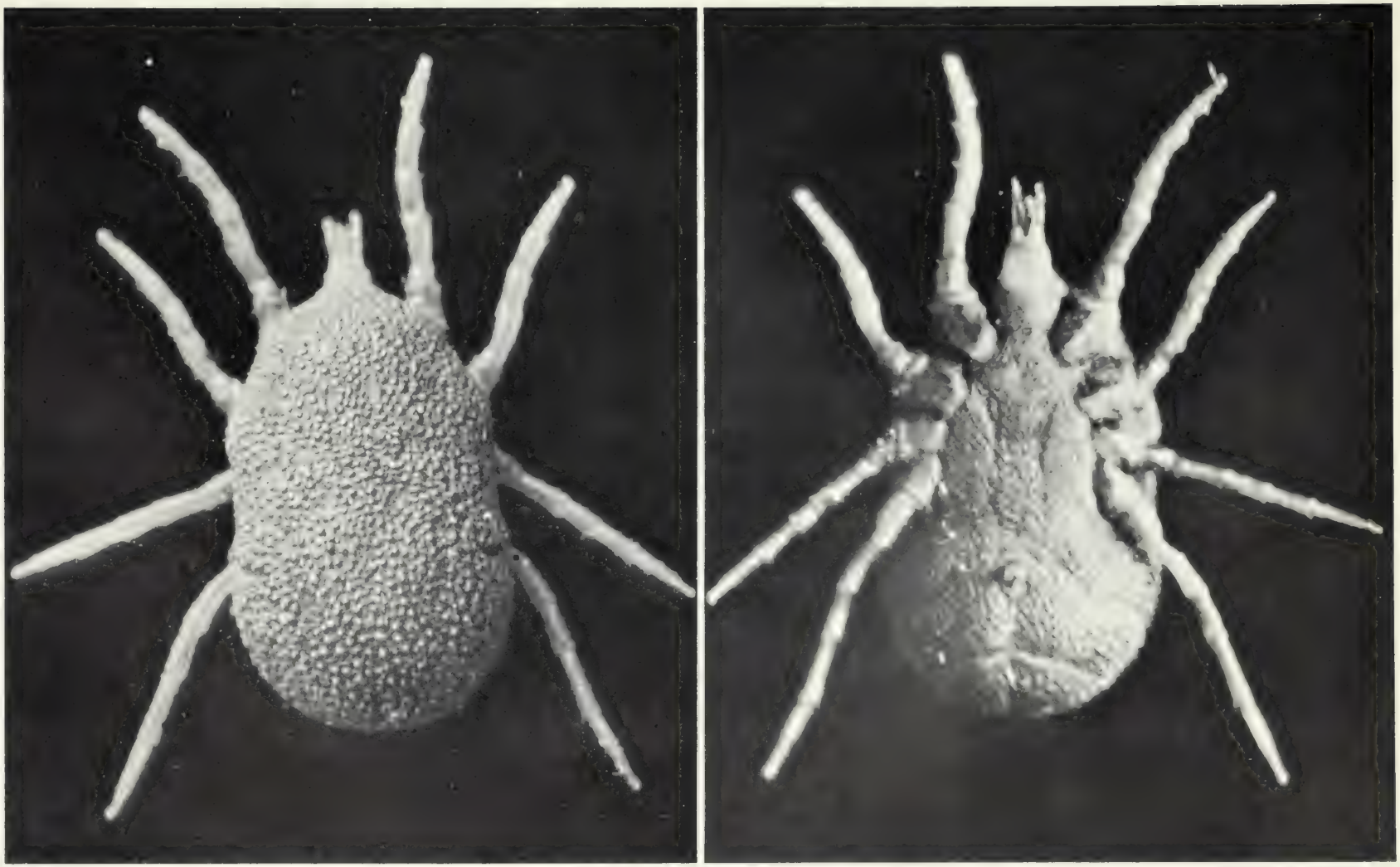
Dorsal

FEMALE

Ventral







Dorsal NYMPH Ventral

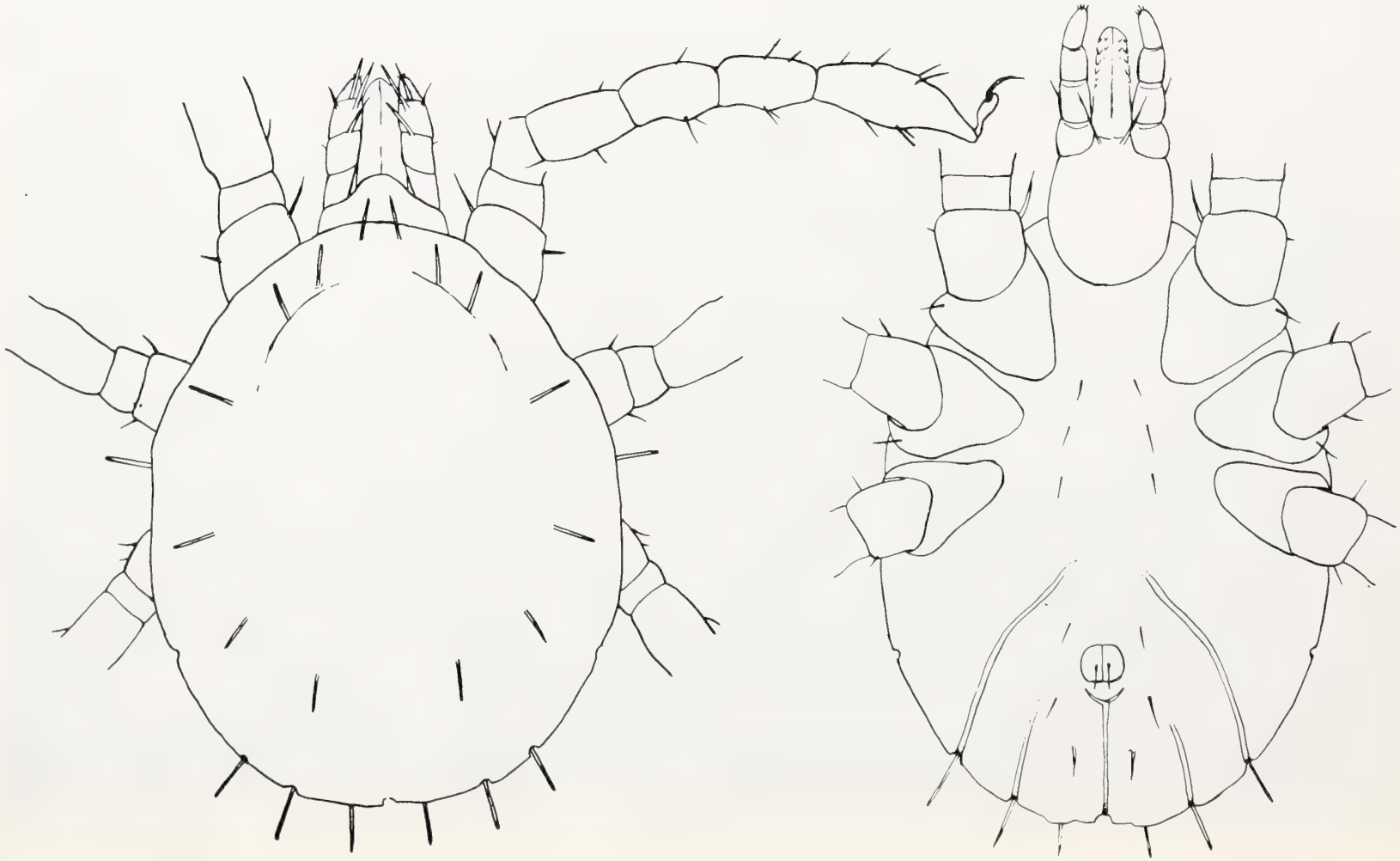
Ornithodoros turicata

Ornithodoros turicata

LARVA

Dorsal

Ventral



Dorsal

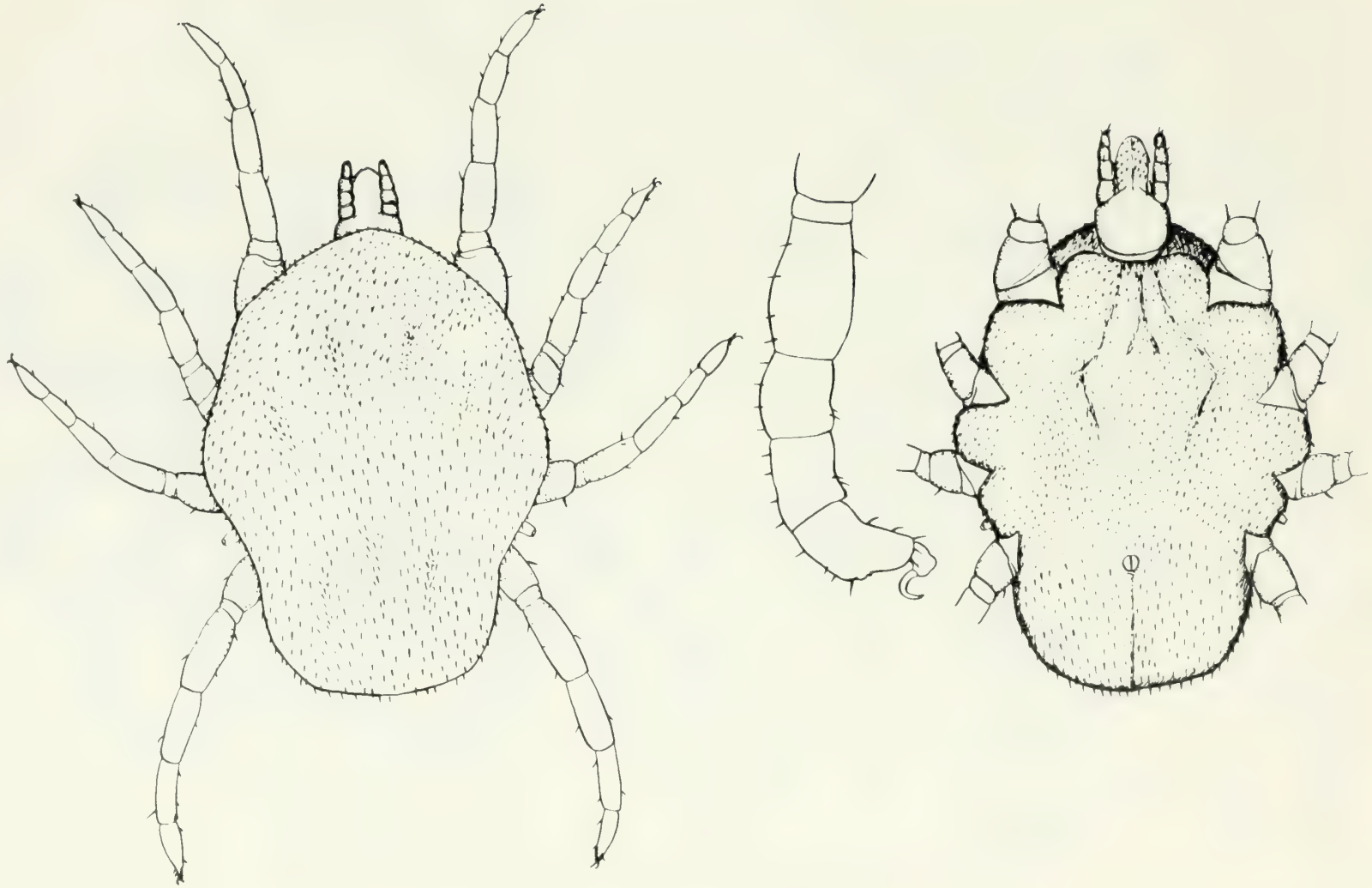
MALE

Ventral

Otobius megnini

Otobius megnini

Dorsal **FEMALE** Ventral



Dorsal

NYMPH

Ventral

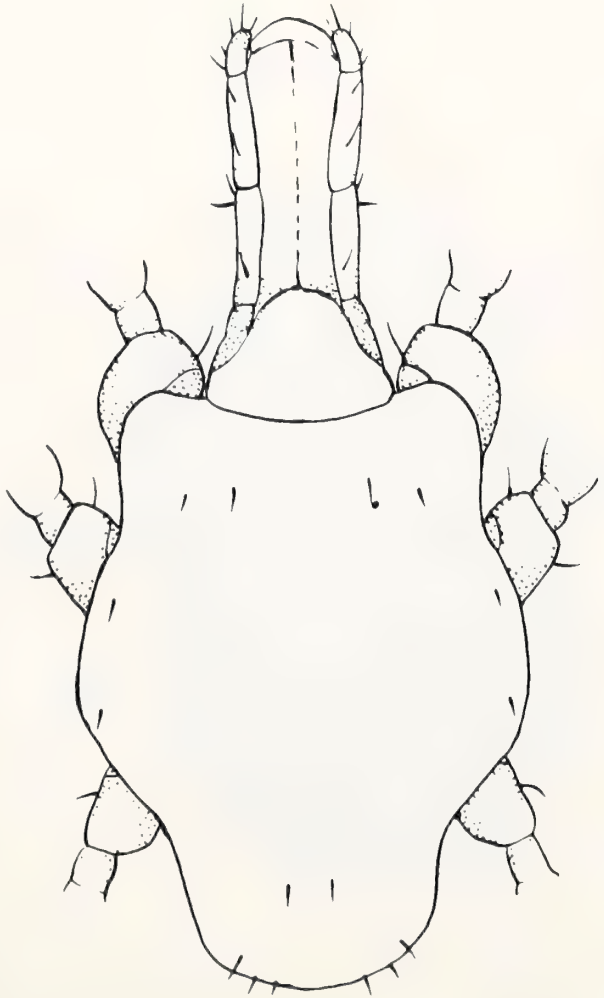
Otobius megnini

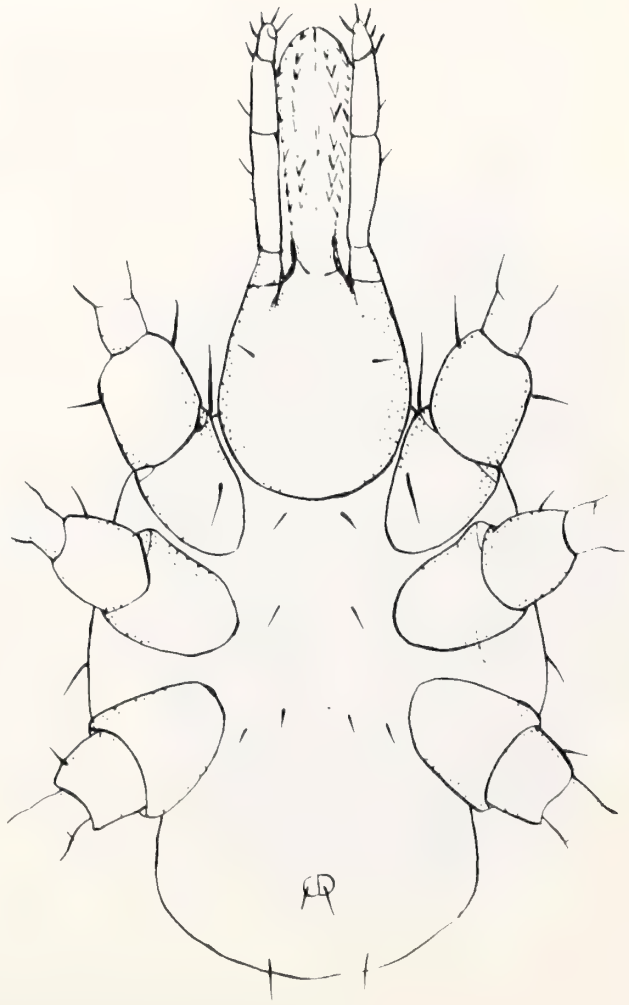
Otobius megnini

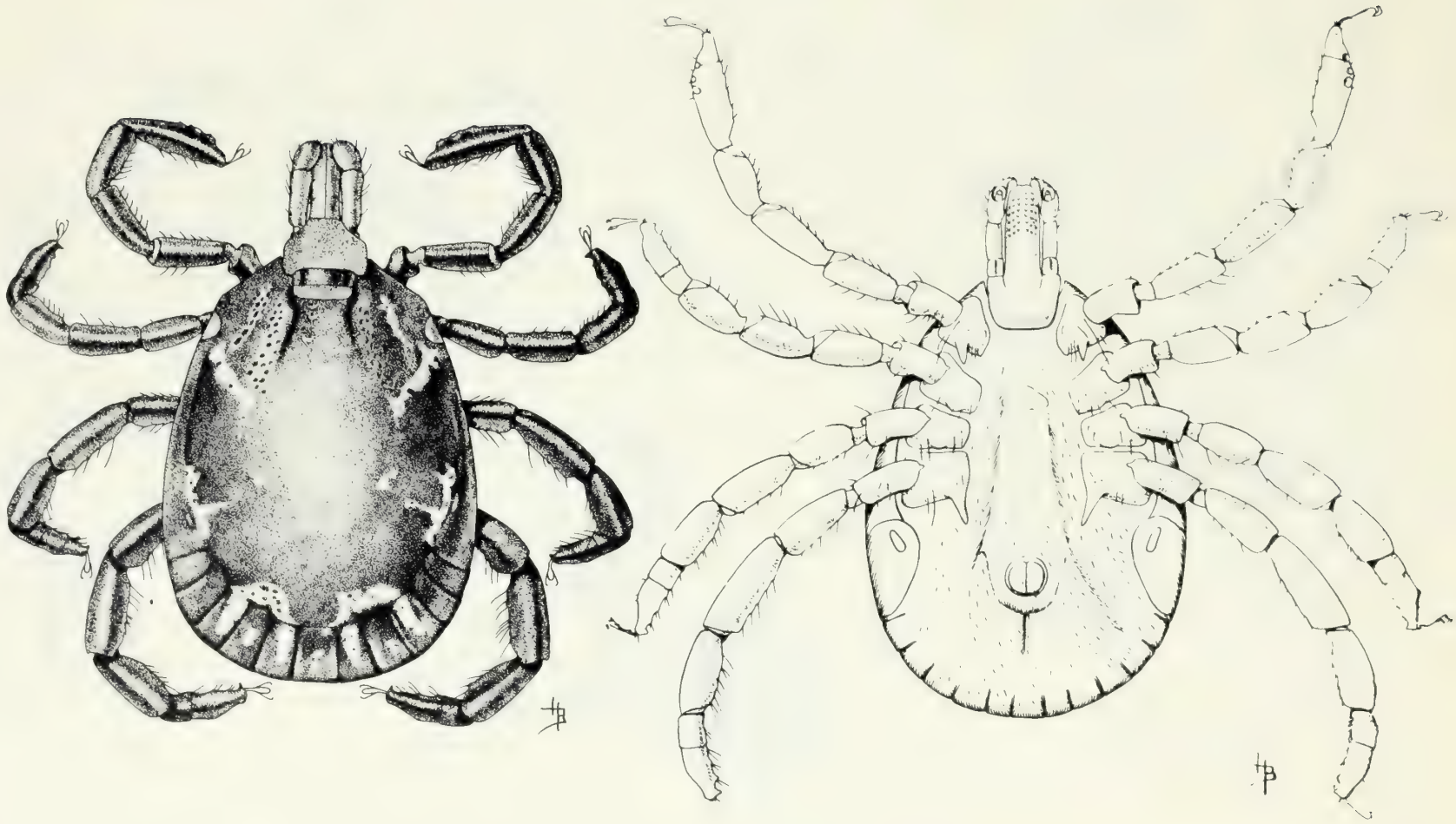
Dorsal

LARVA

Ventral







Dorsal

MALE

Ventral

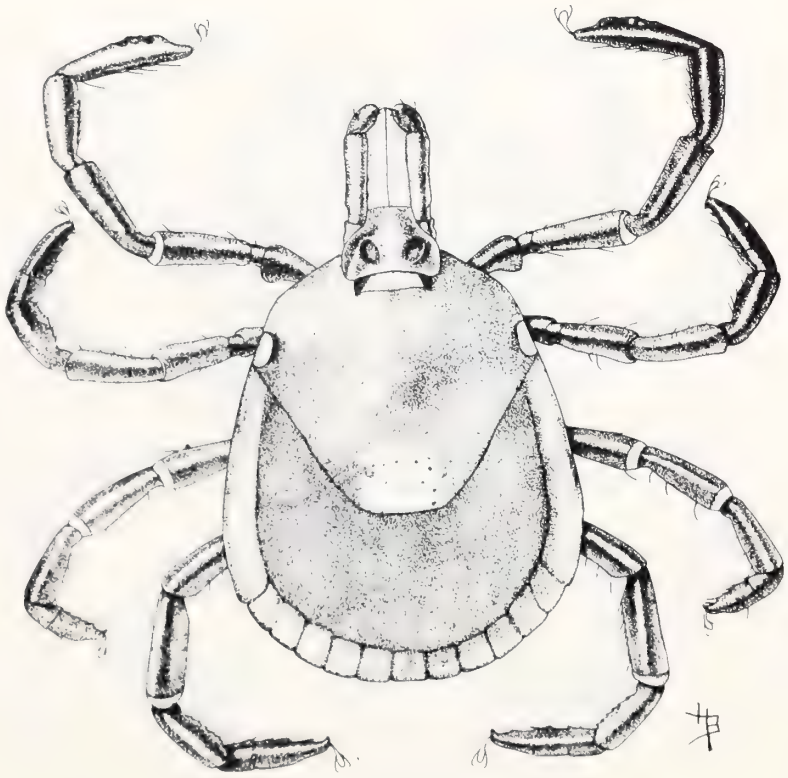
Amblyomma americanum

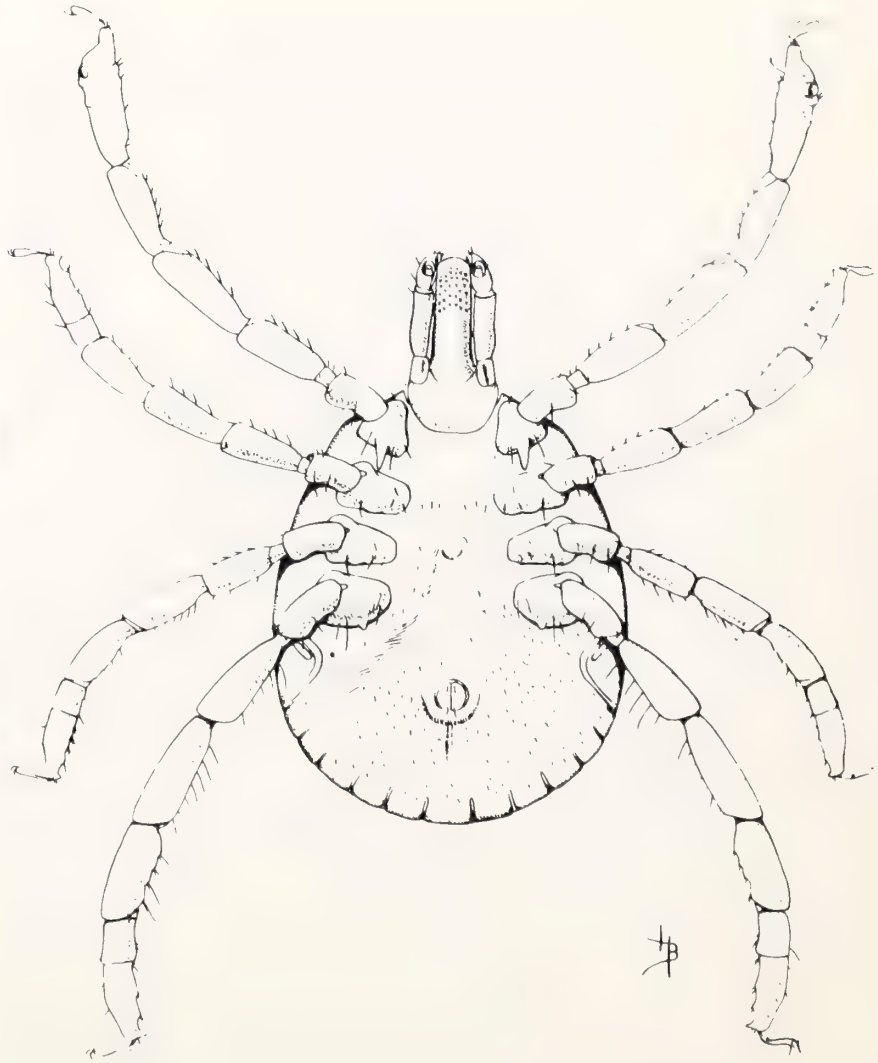
Amblyomma americanum

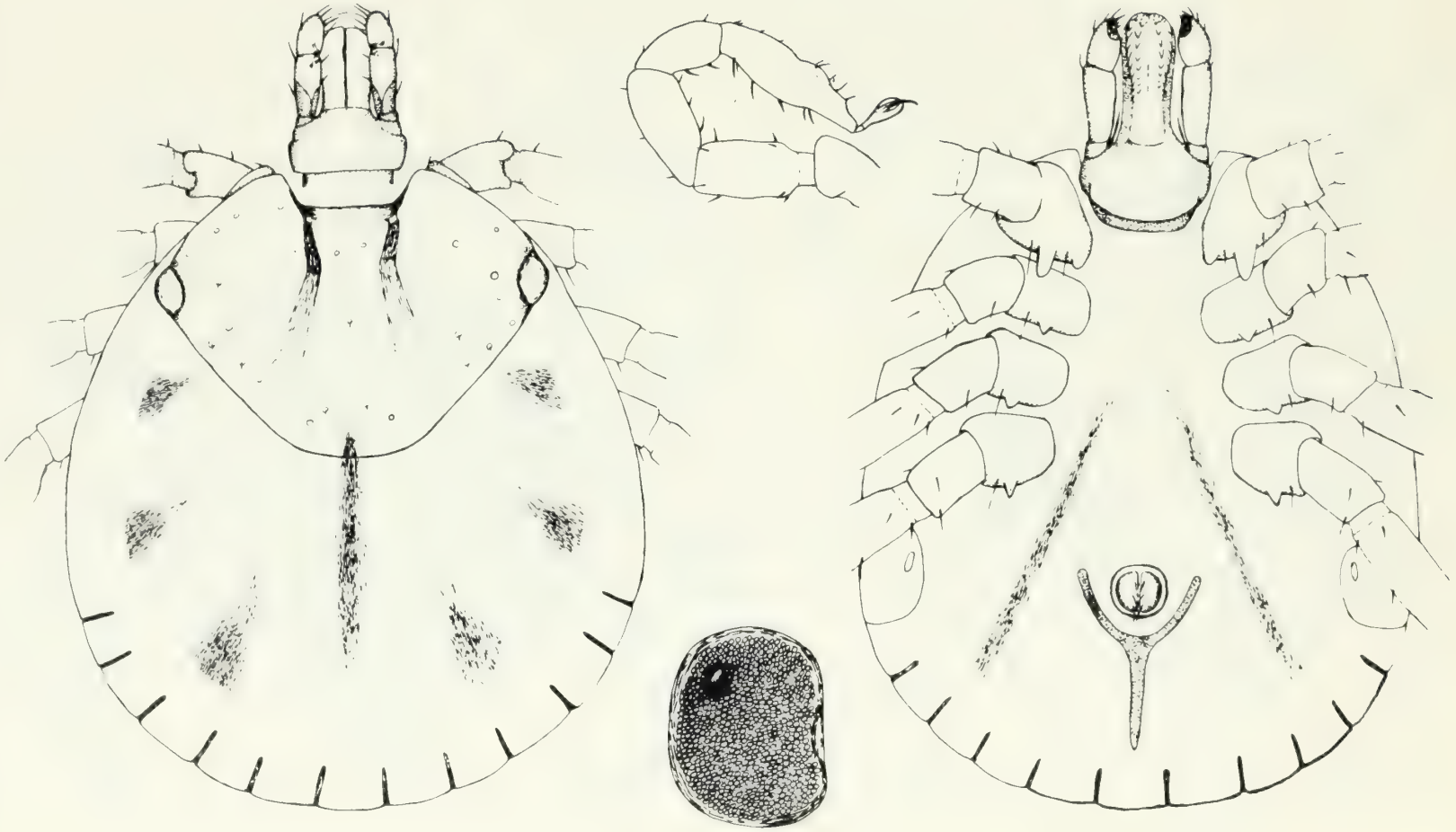
Dorsal

FEMALE

Ventral







Spiracular Plate

NYMPH

Dorsal

Ventral

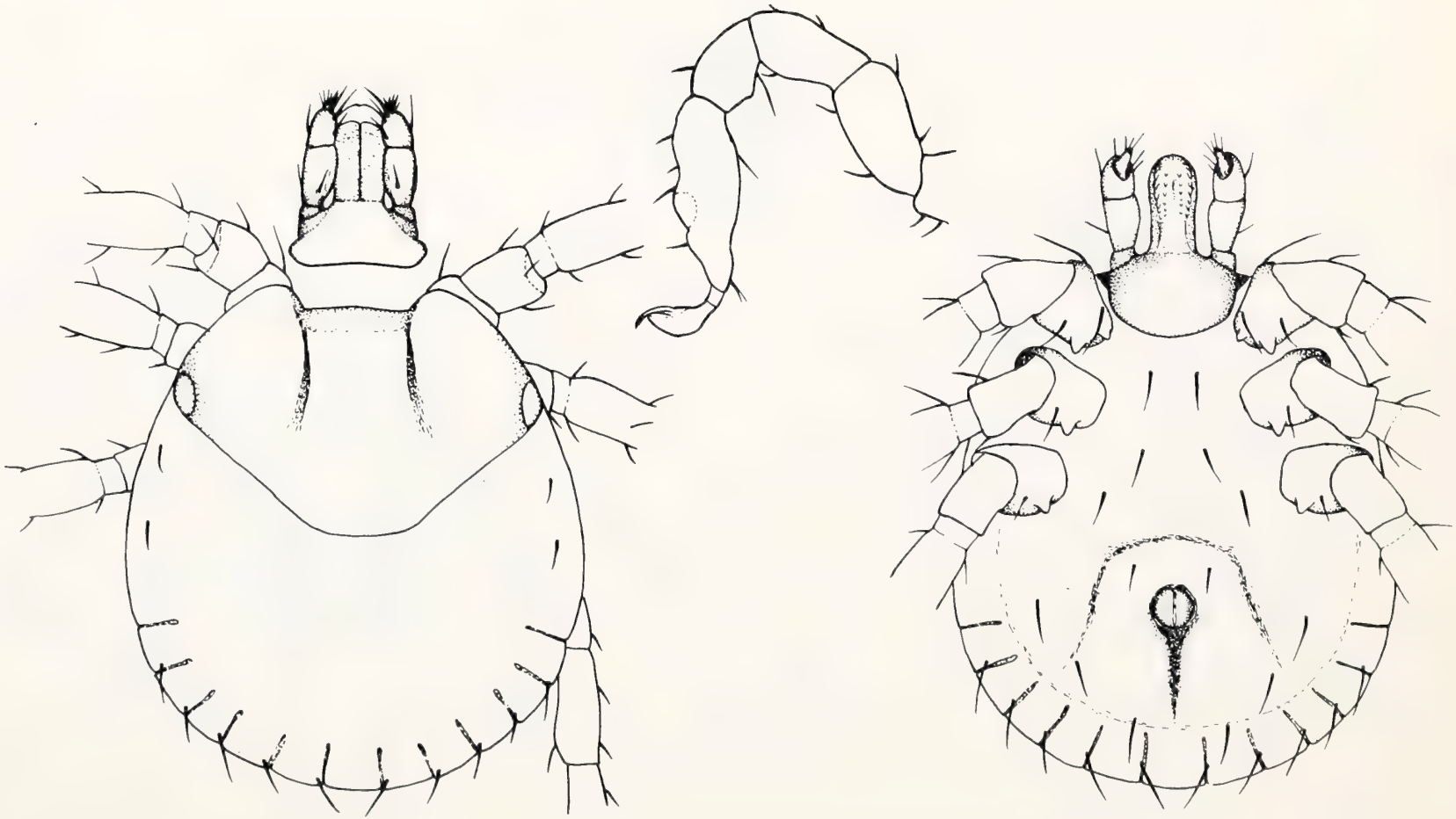
Amblyomma americanum

Amblyomma americanum

Dorsal

LARVA

Ventral



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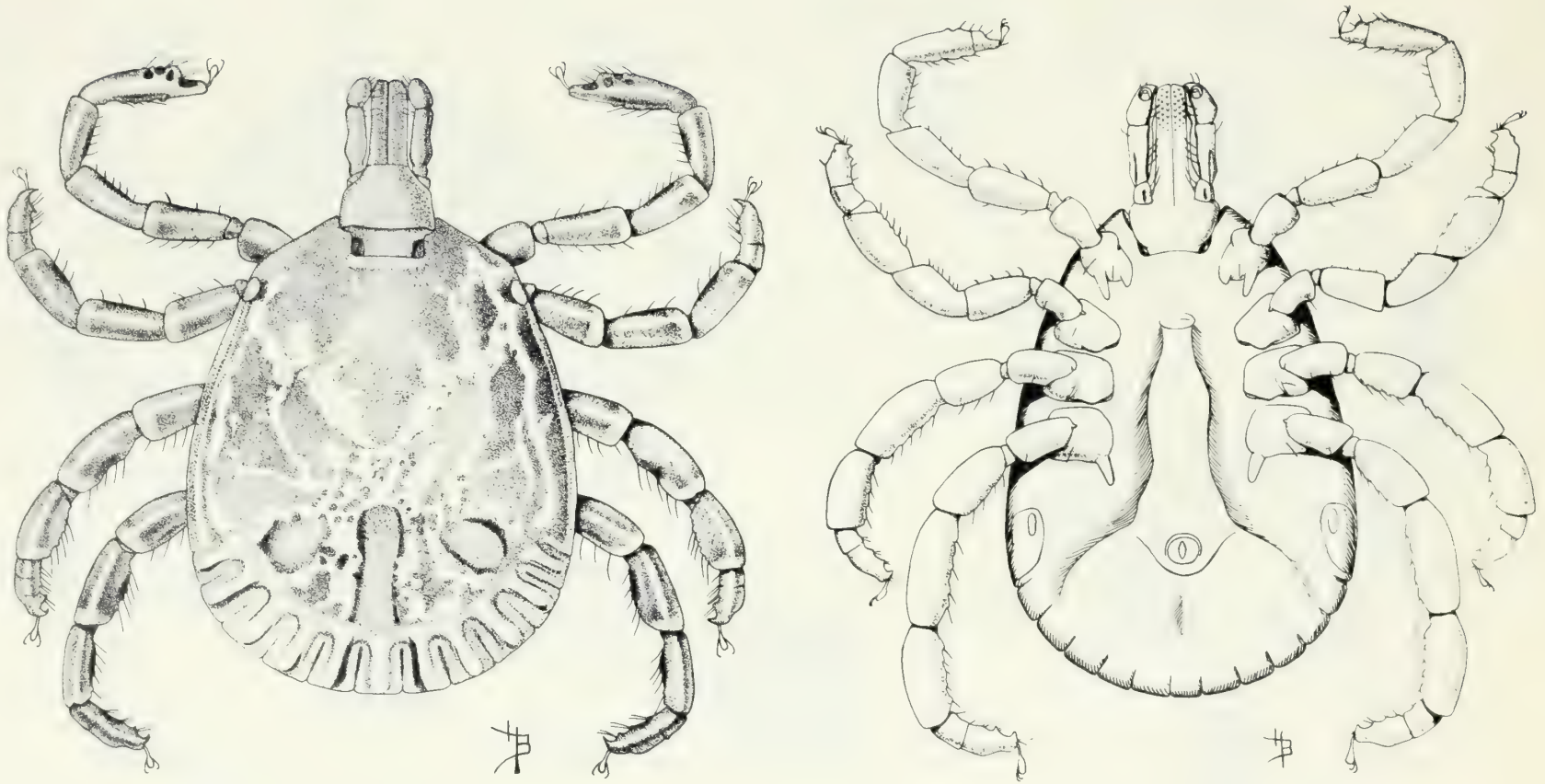


Dorsal

MALE

Ventral

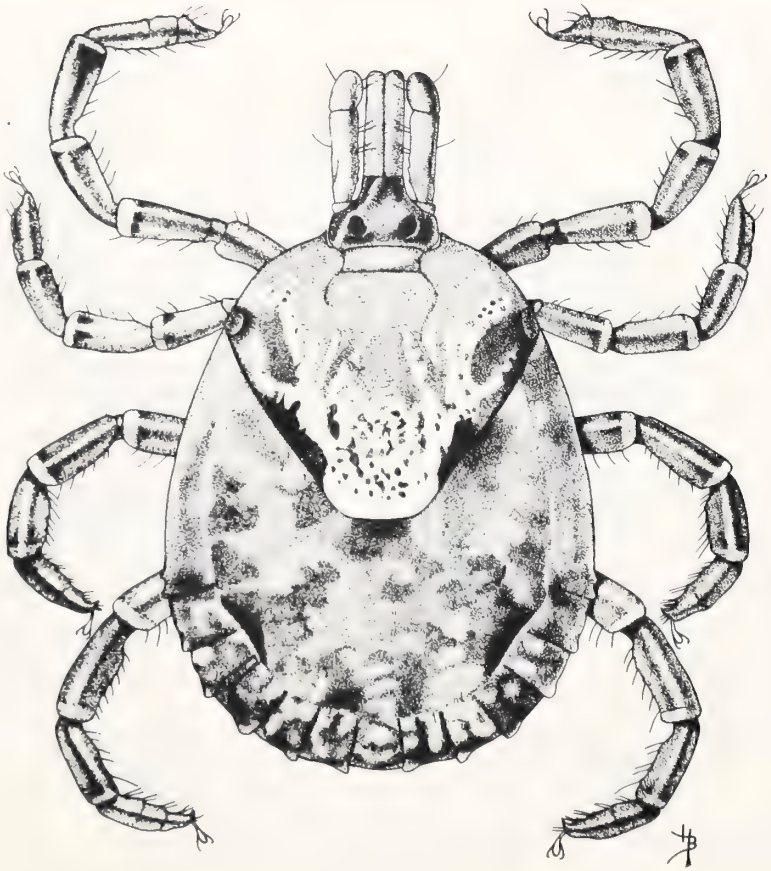
Amblyomma cajennense

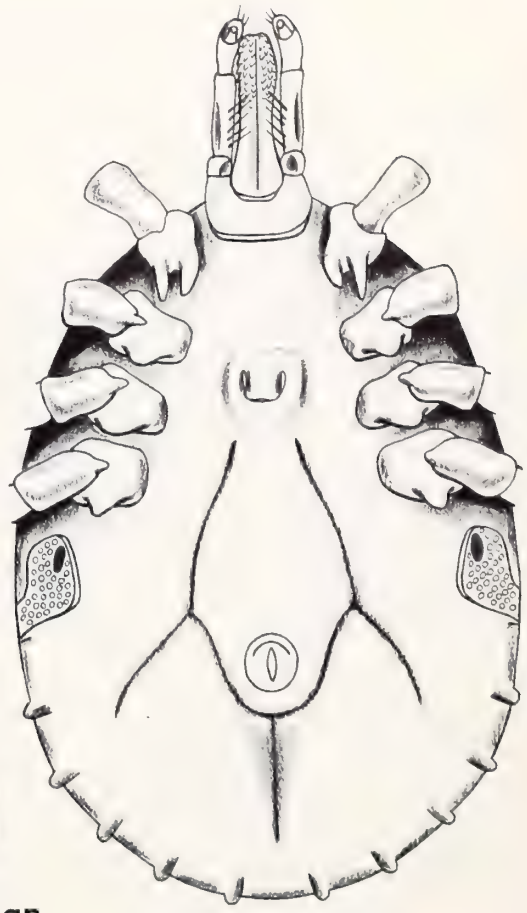
Amblyomma cajennense

Dorsal

FEMALE

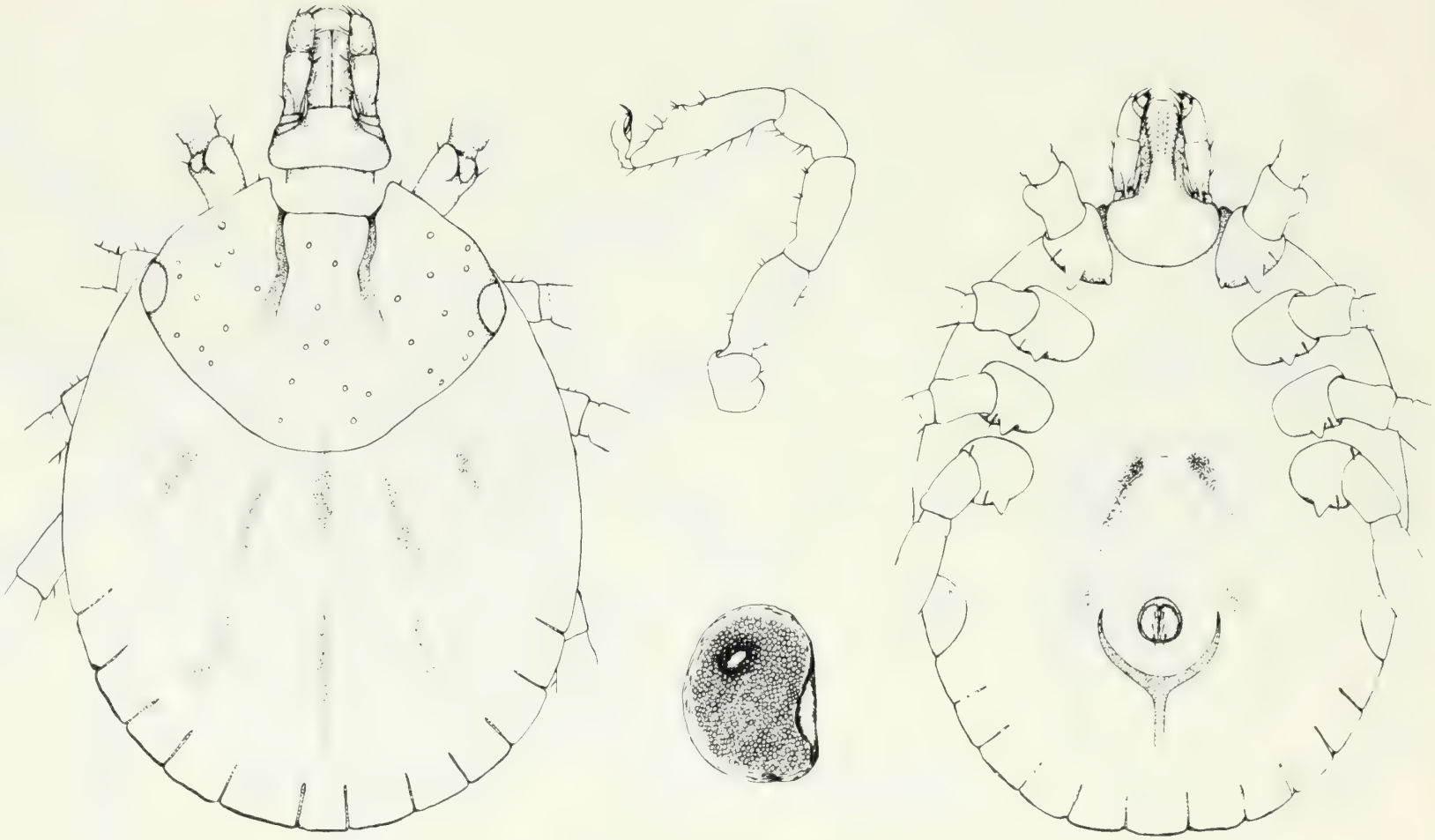
Ventral





Genital Organ

769-385 O-65—8



Spiracular Plate

Dorsal

NYMPH

Ventral

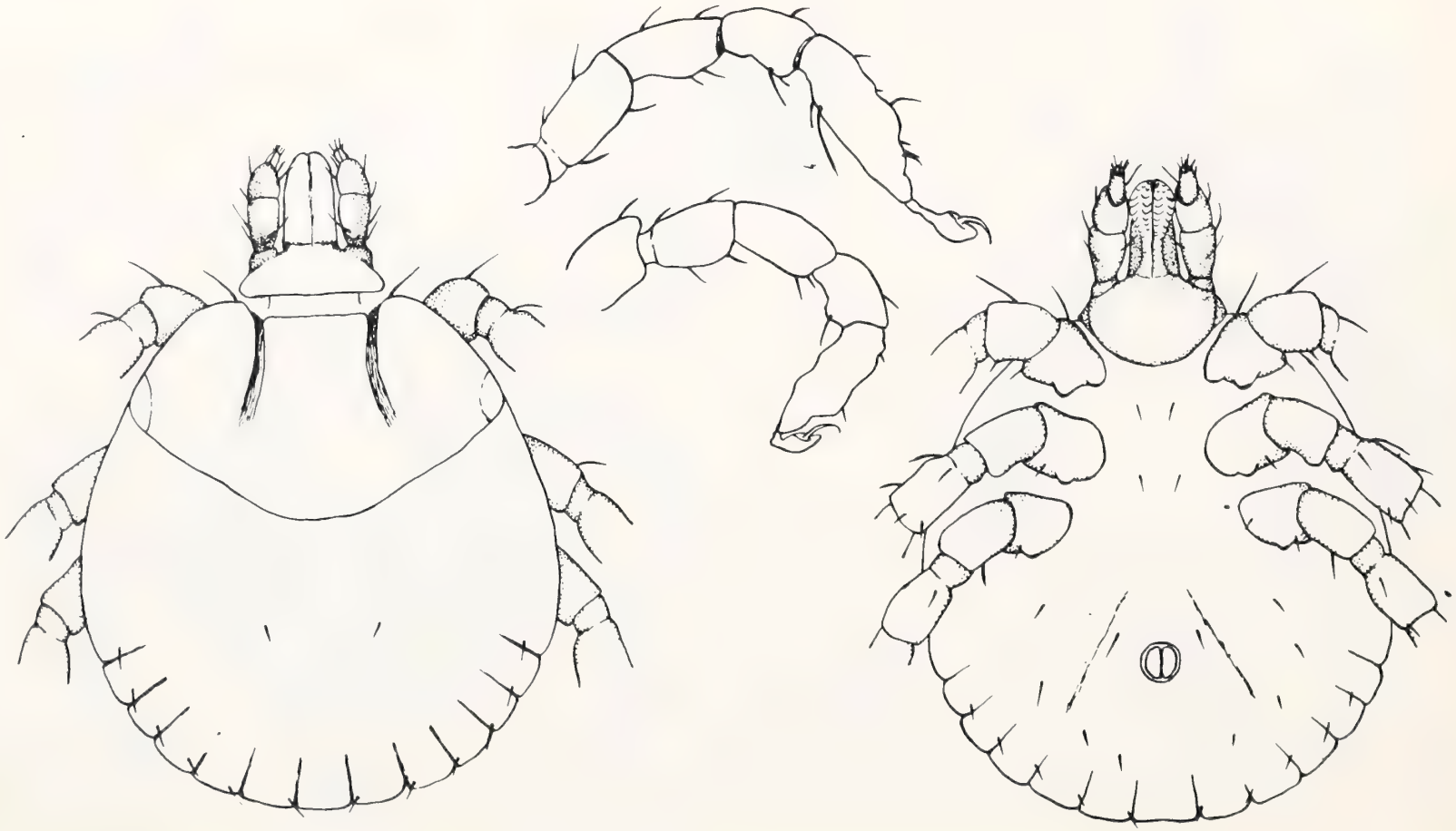
Amblyomma cajennense

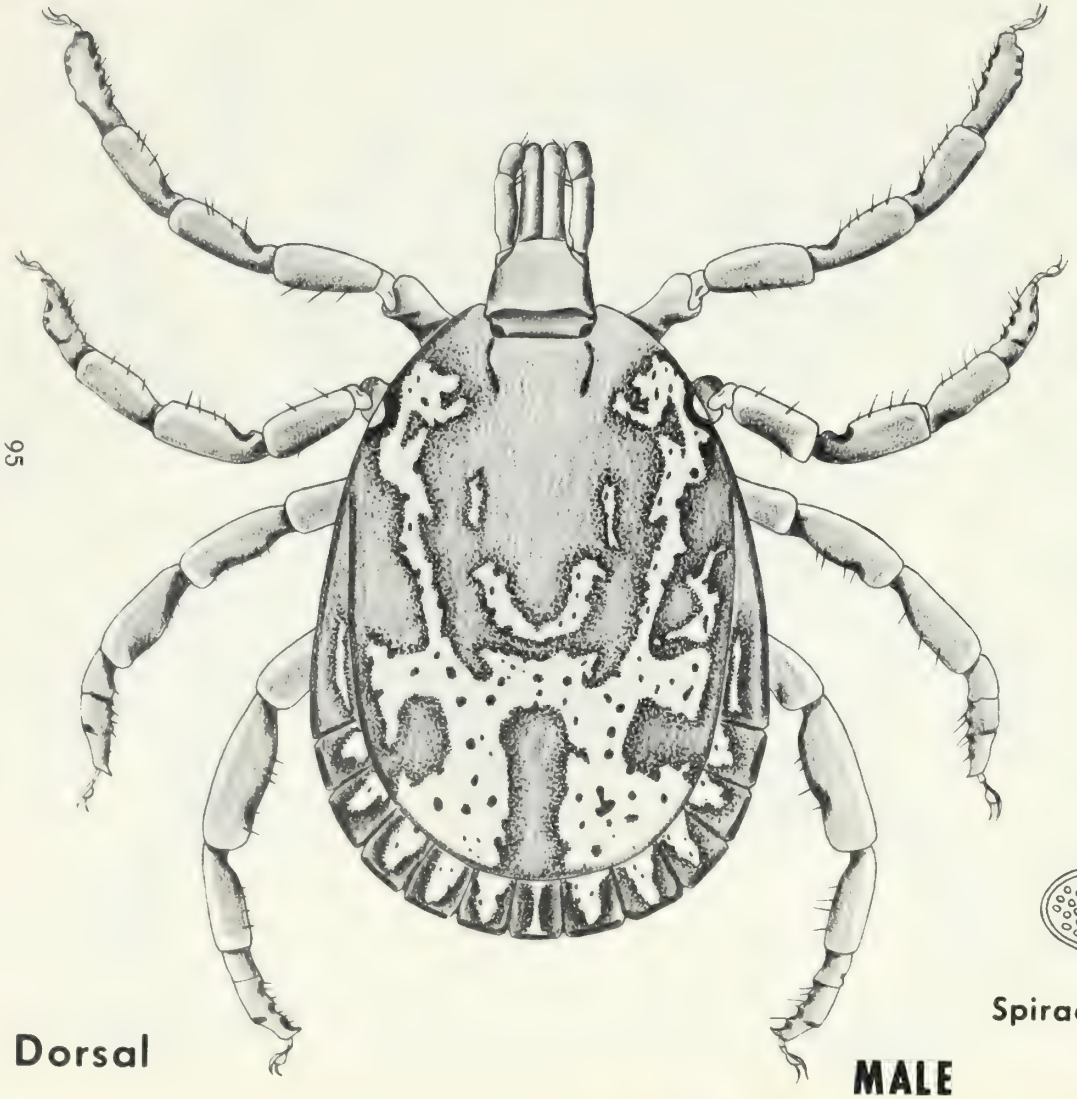
Amblyomma cajennense

LARVA

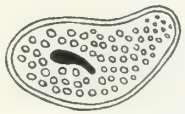
Dorsal

Ventral

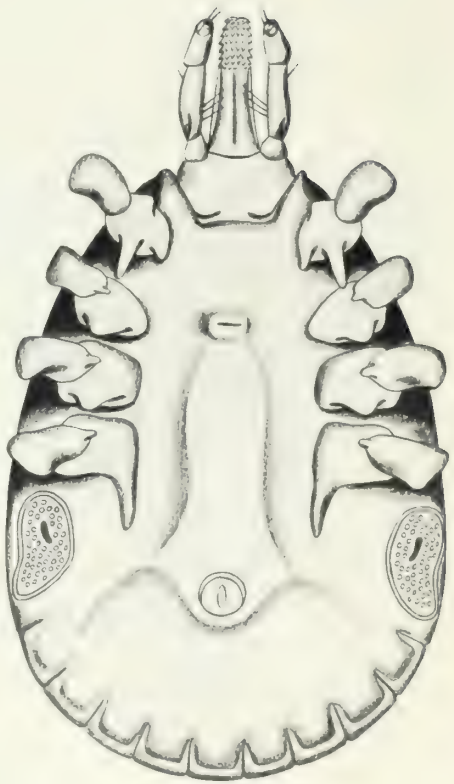




Dorsal



Spiracular Plate



Ventral

MALE

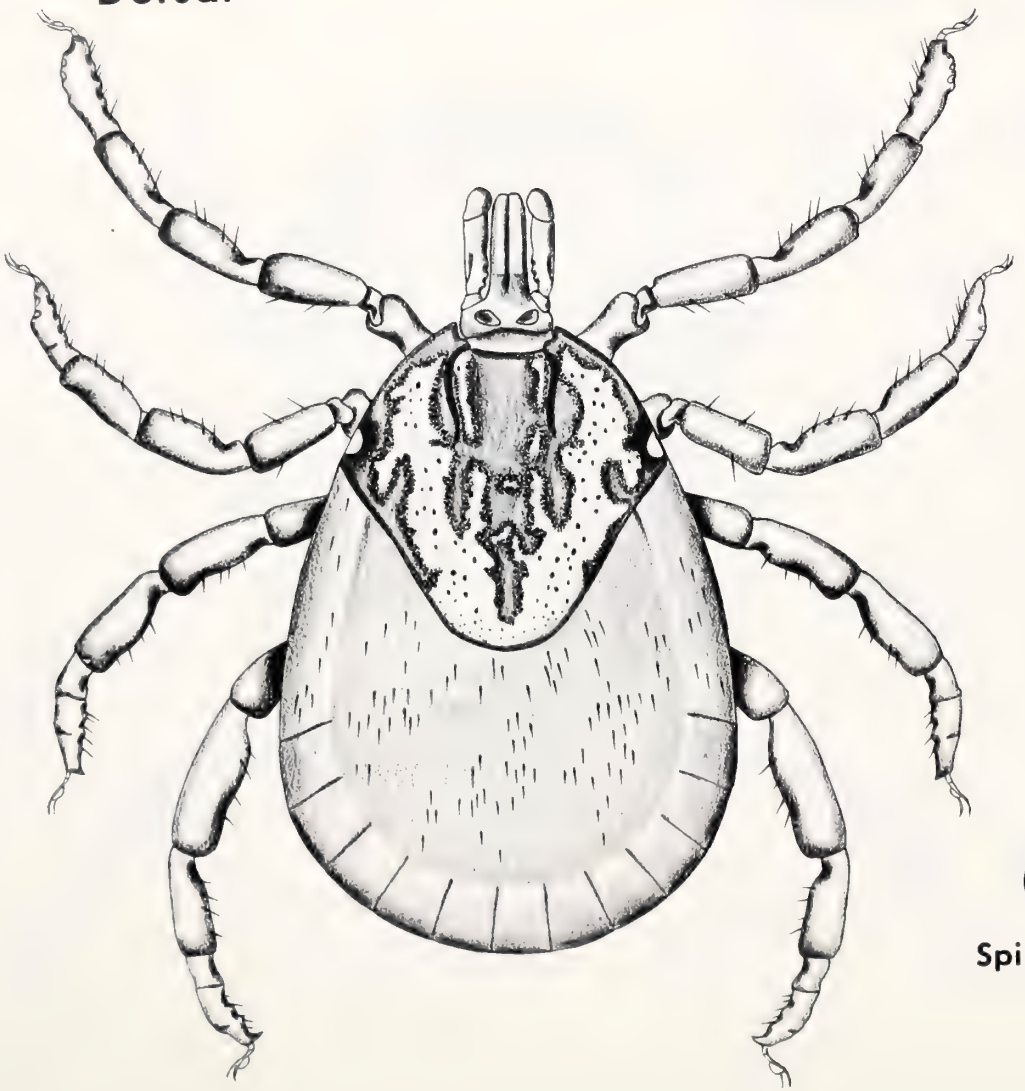
Amblyomma imitator

Amblyomma imitator

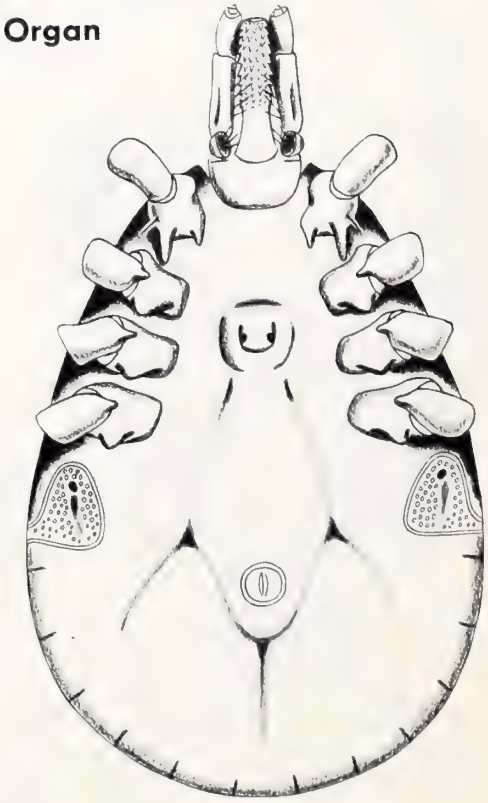
Dorsal

FEMALE

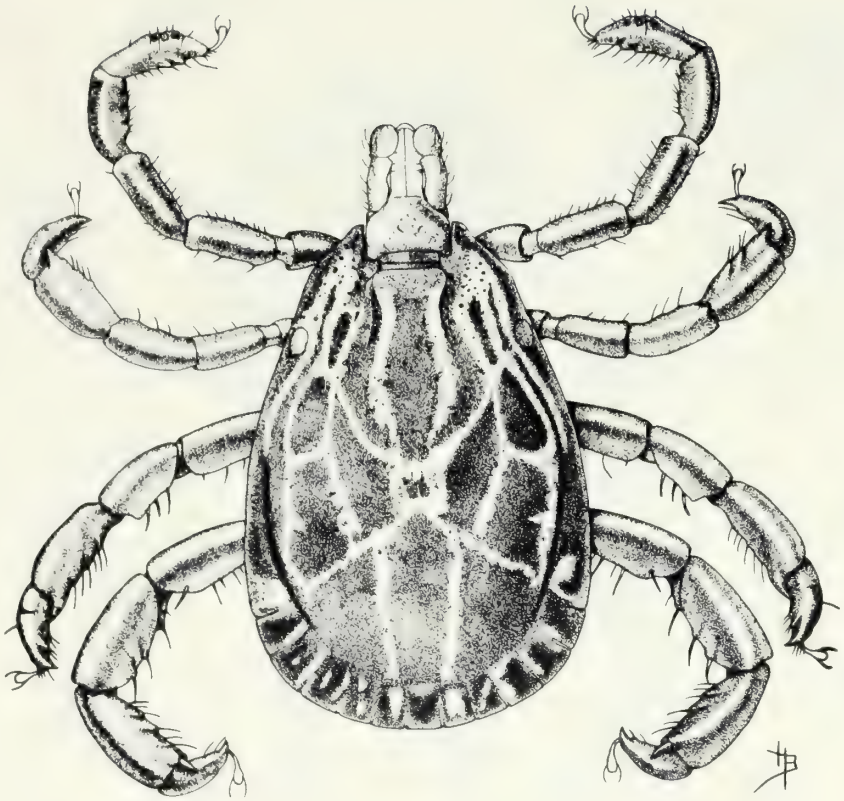
Ventral

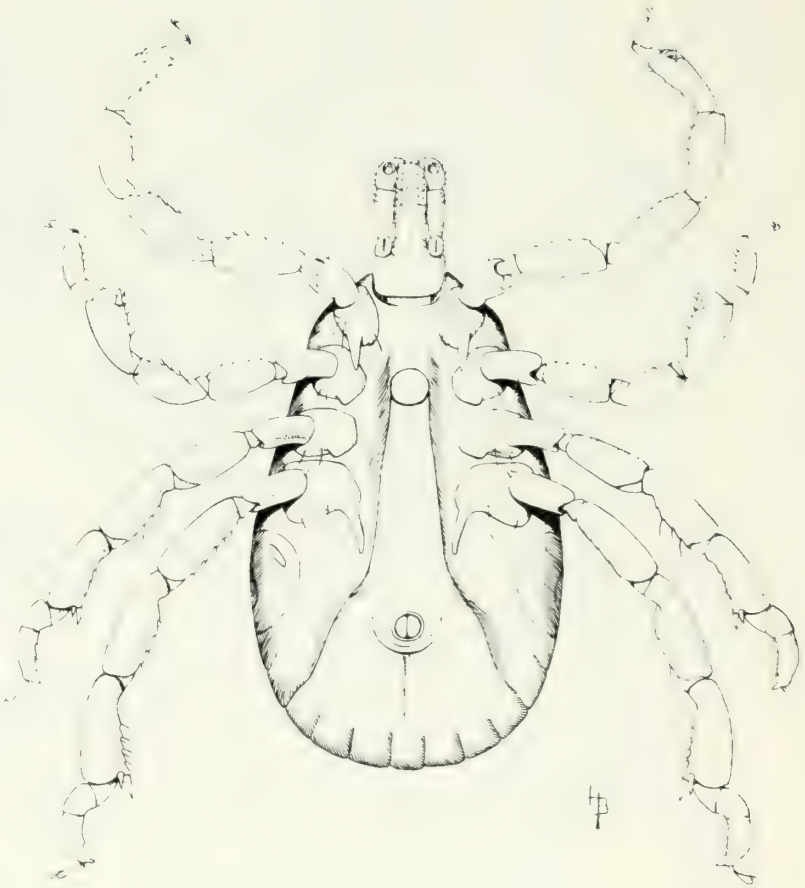


Genital Organ



Spiracular Plate





Dorsal

MALE

Ventral

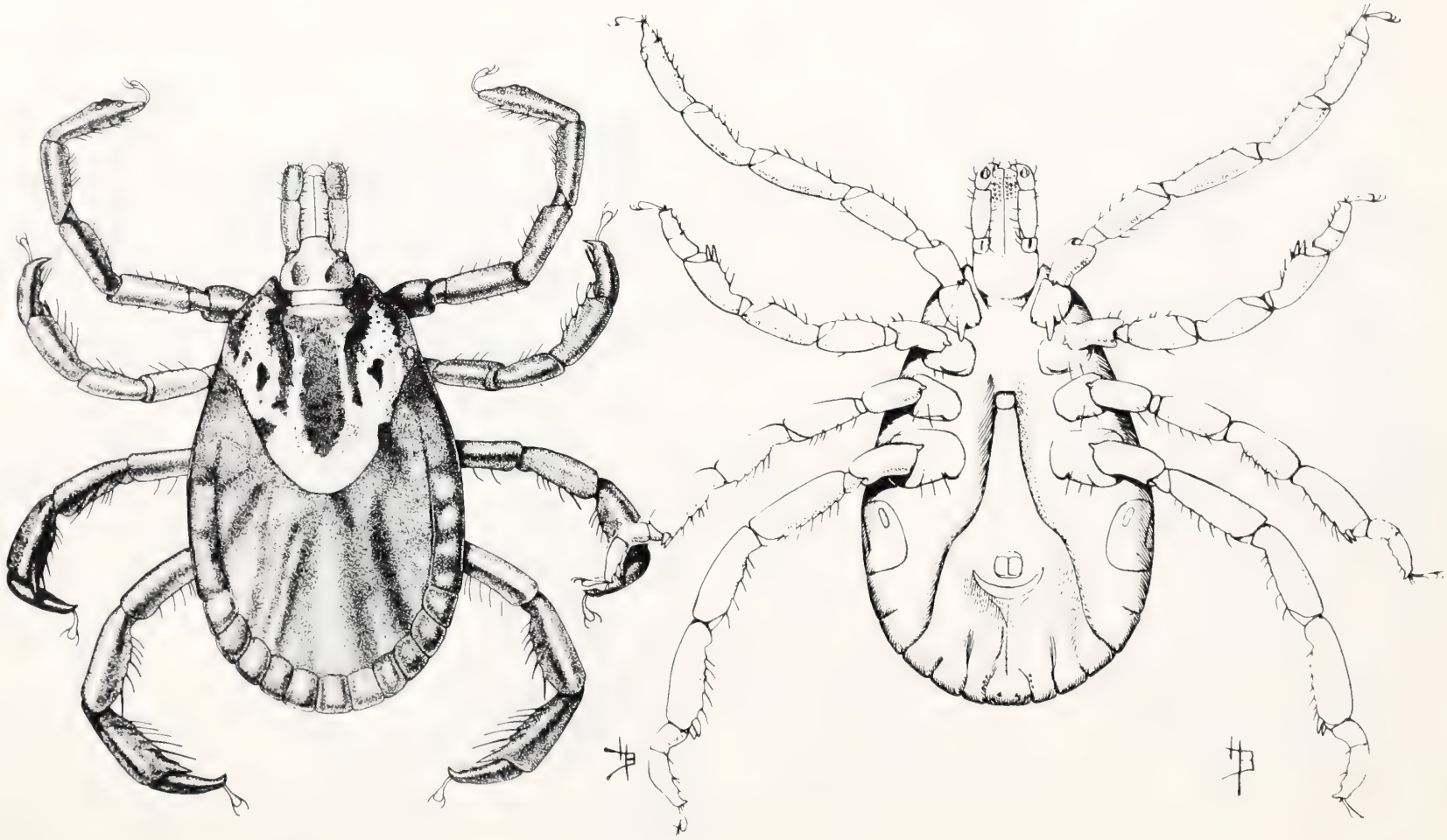
Amblyomma maculatum

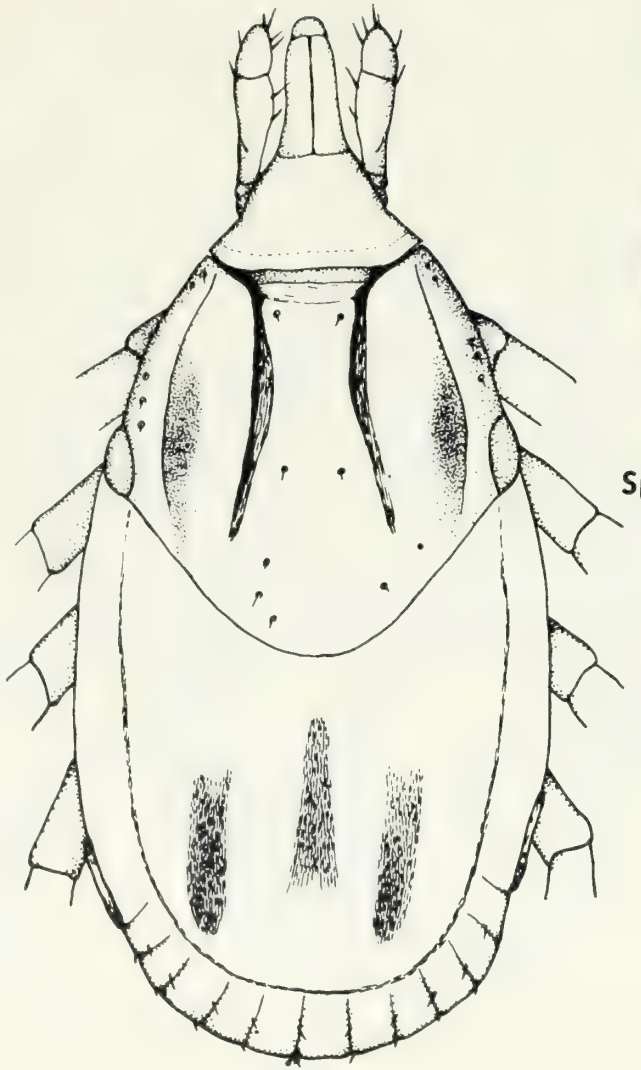
Amblyomma maculatum

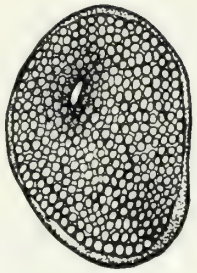
Dorsal

FEMALE

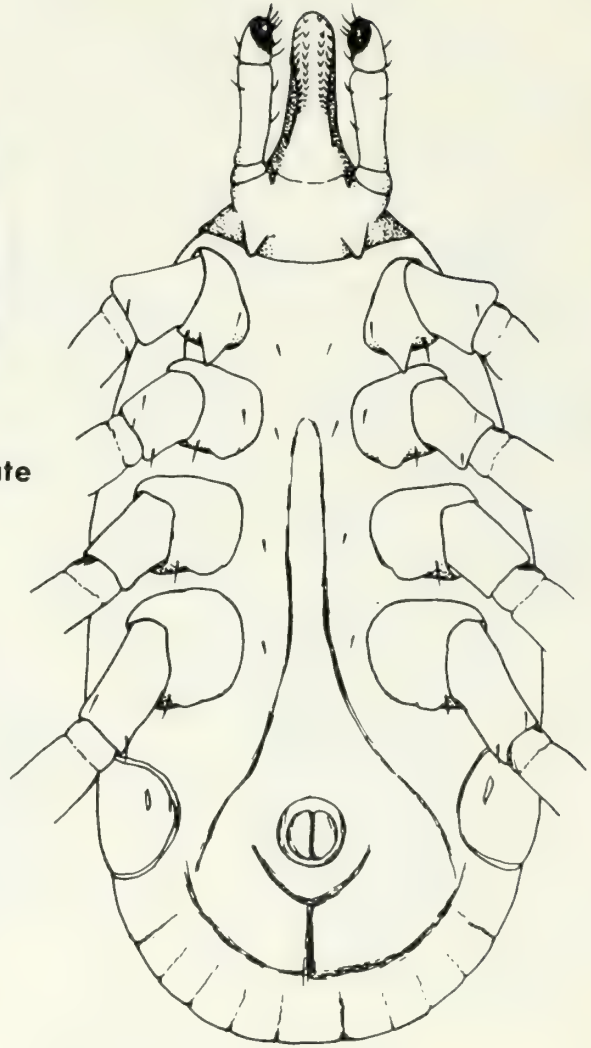
Ventral







Spiracular Plate



Dorsal

NYMPH

Ventral

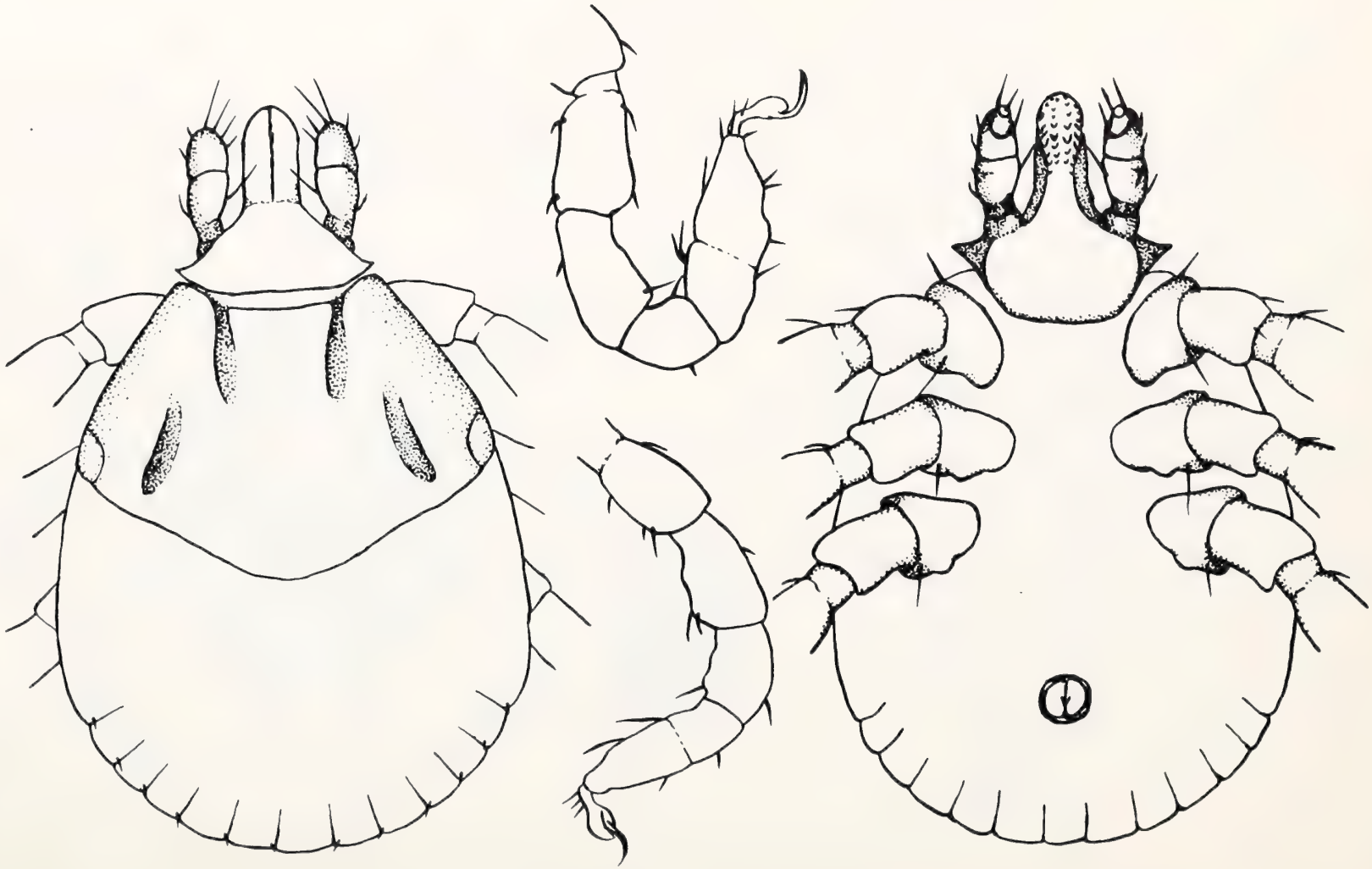
Amblyomma maculatum

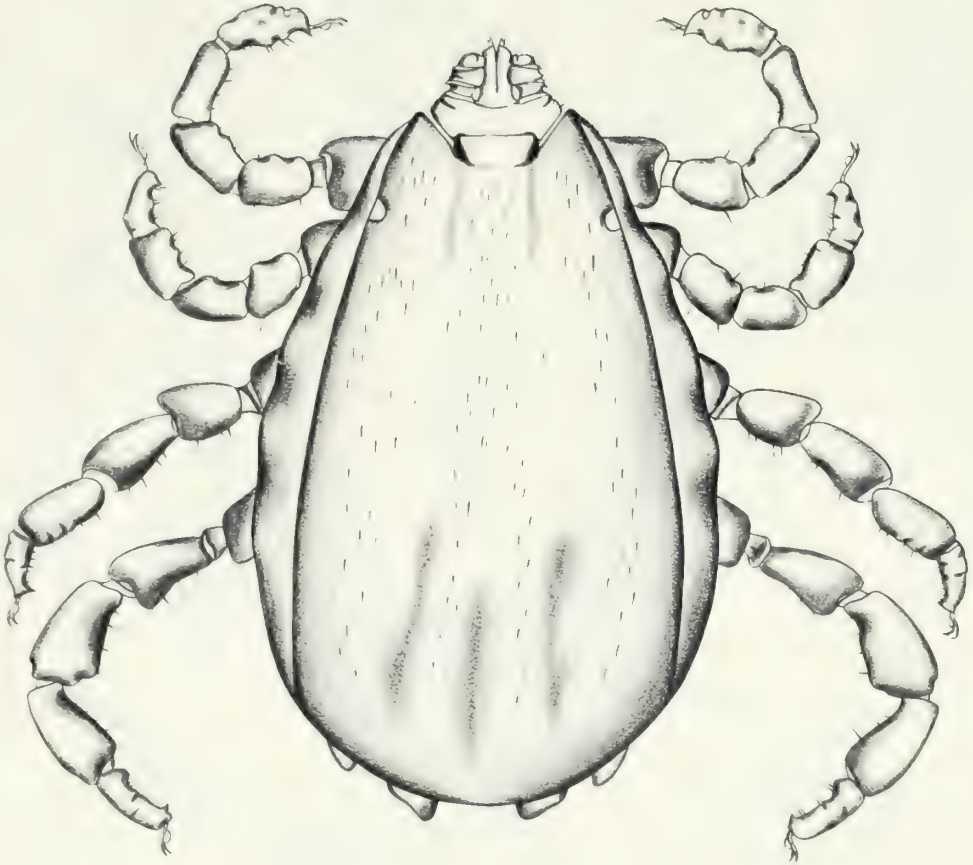
Amblyomma maculatum

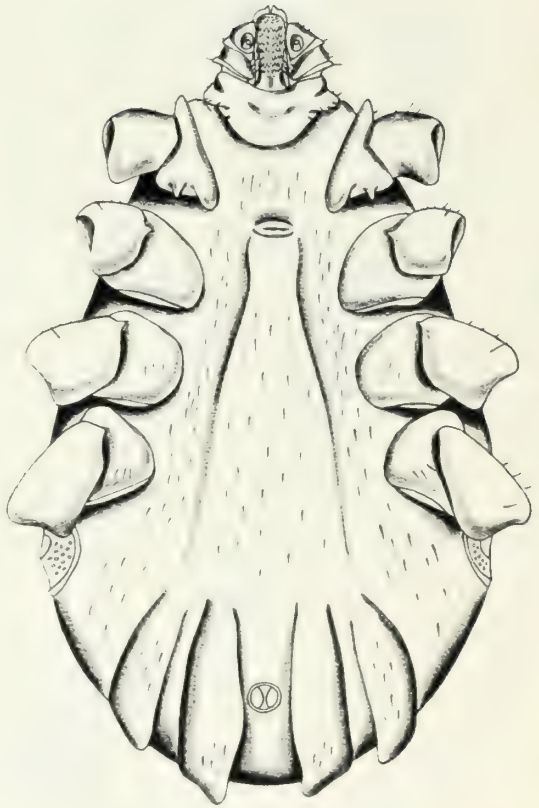
Dorsal

LARVA

Ventral







Dorsal

MALE

Ventral

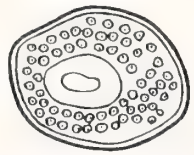
Boophilus annulatus

Boophilus annulatus

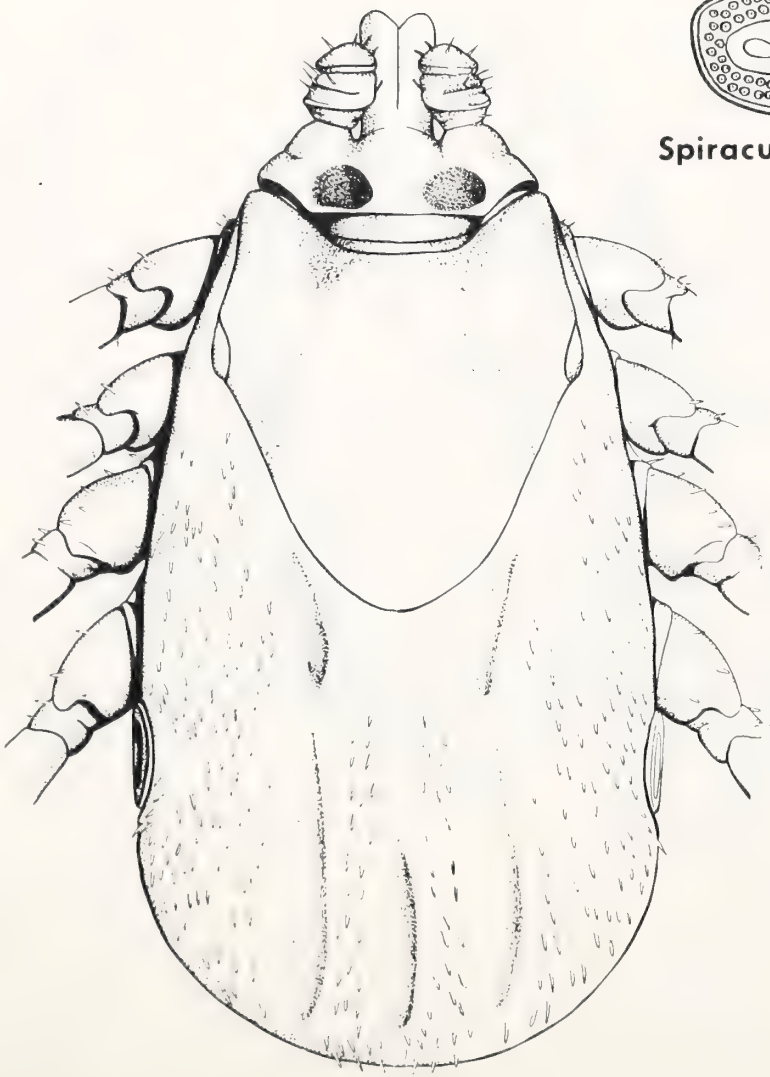
Dorsal

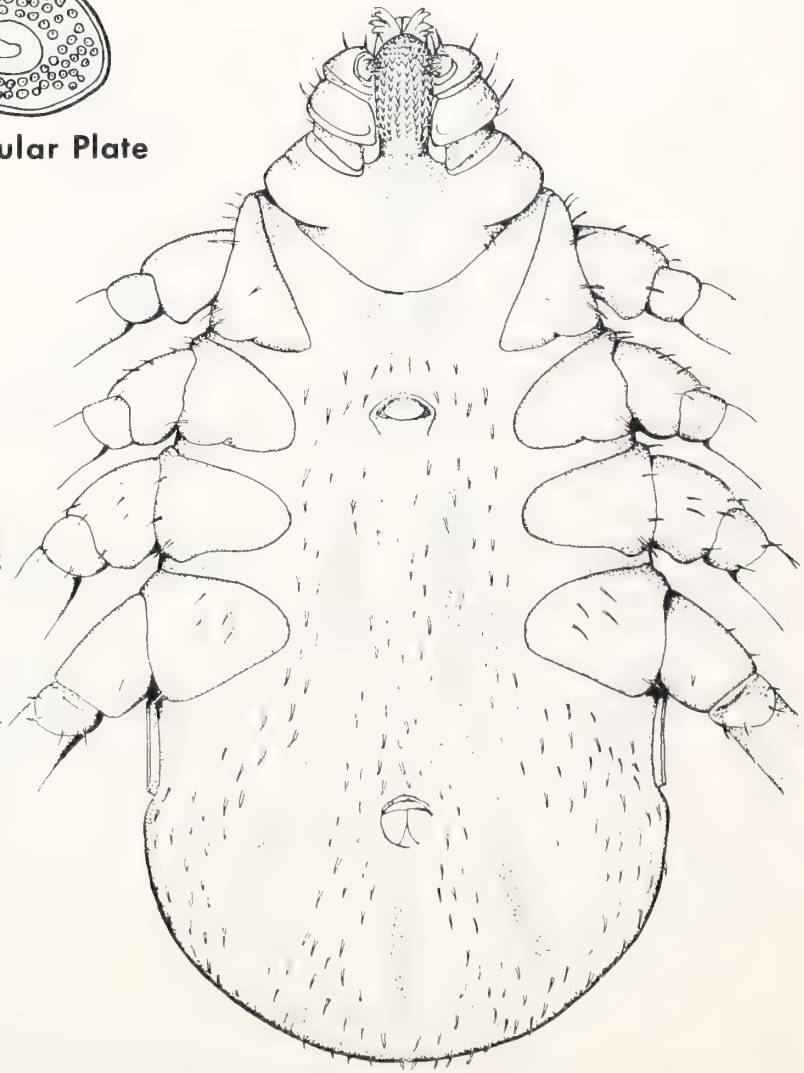
FEMALE

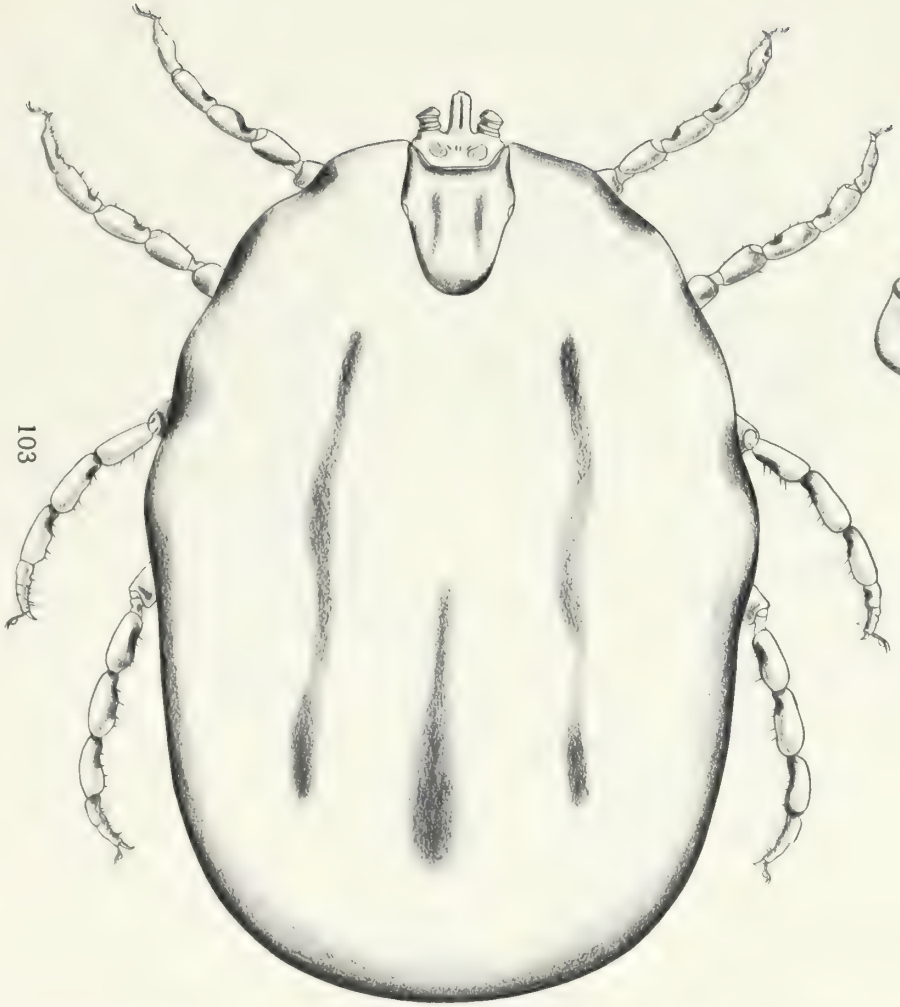
Ventral



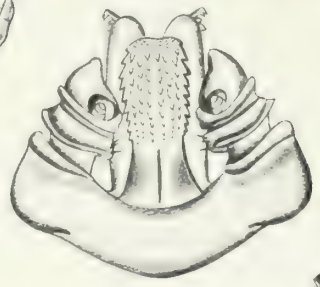
Spiracular Plate

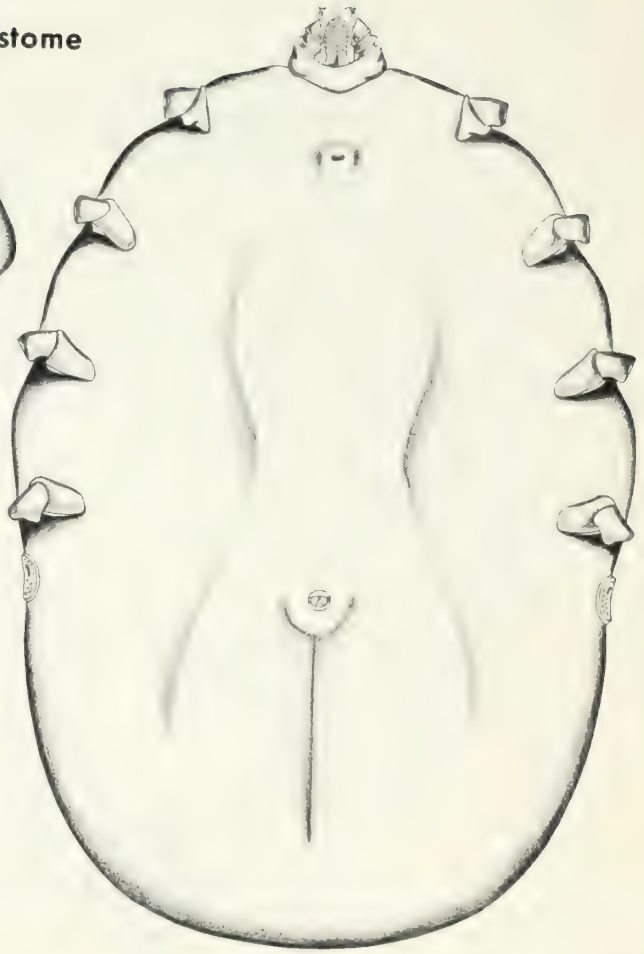






Ventral Hypostome





103

Dorsal

ENGORGED FEMALE

Ventral

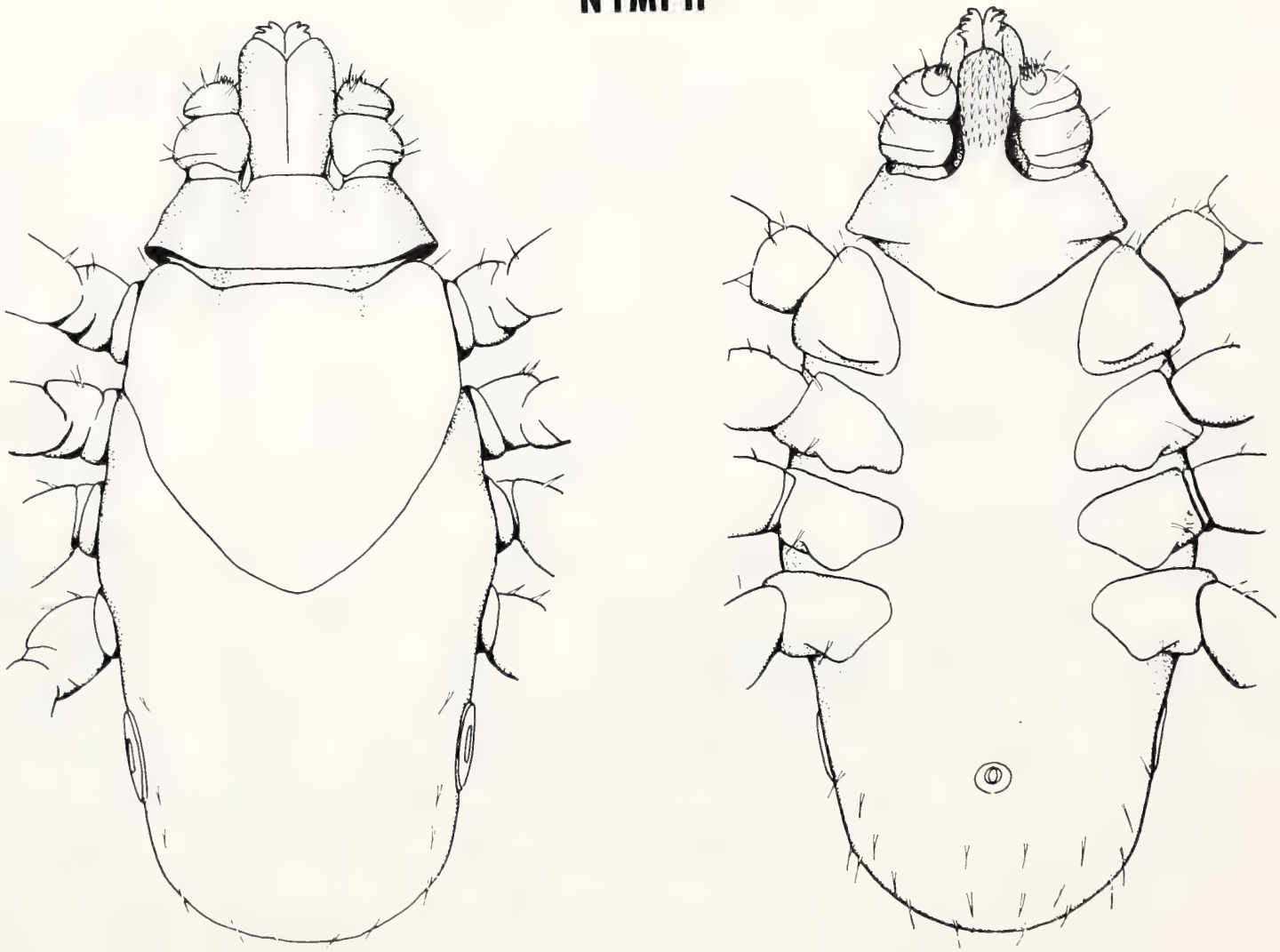
Boophilus annulatus

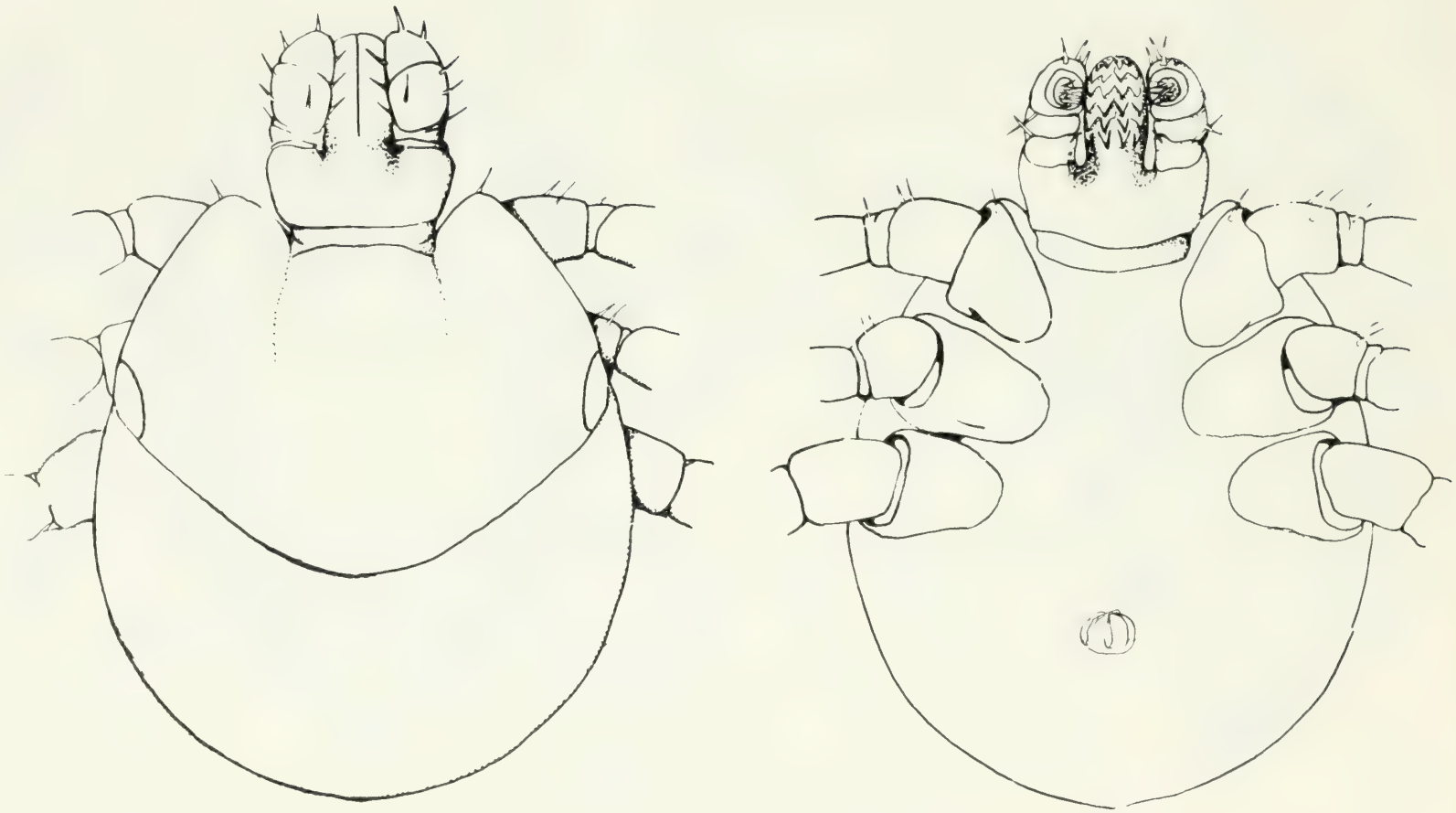
Boophilus annulatus

Dorsal

NYMPH

Ventral





Dorsal

LARVA

Ventral

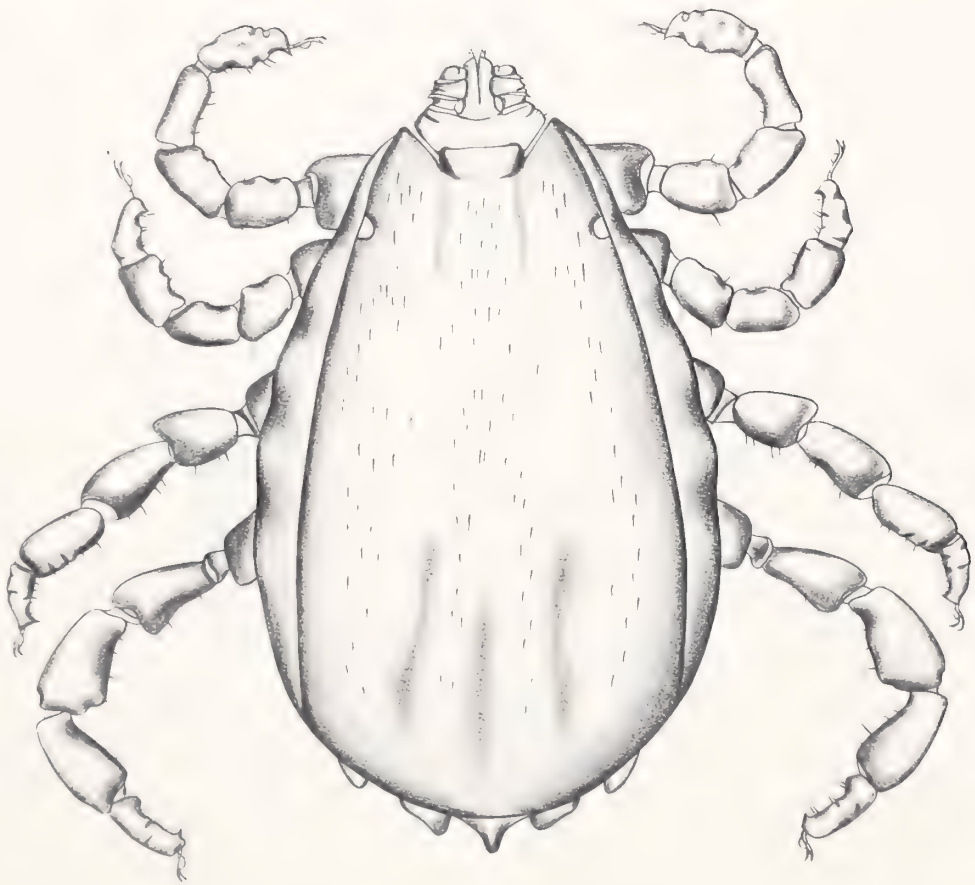
Boophilus annulatus

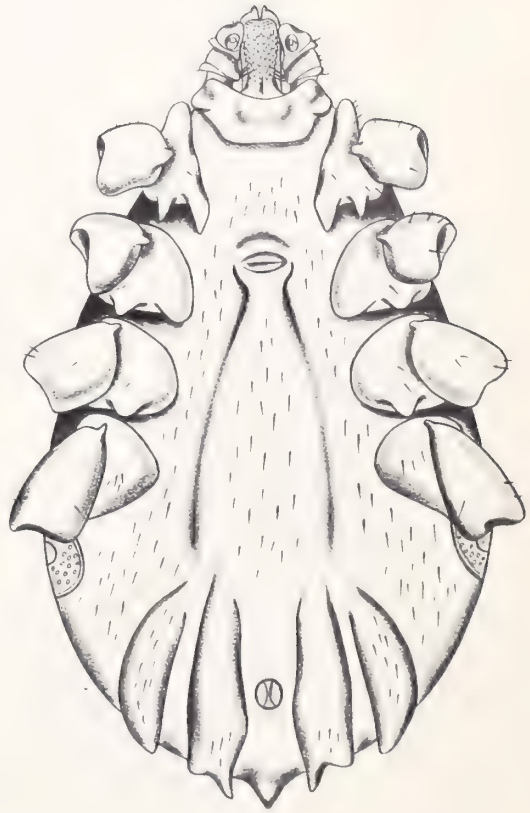
Boophilus microplus

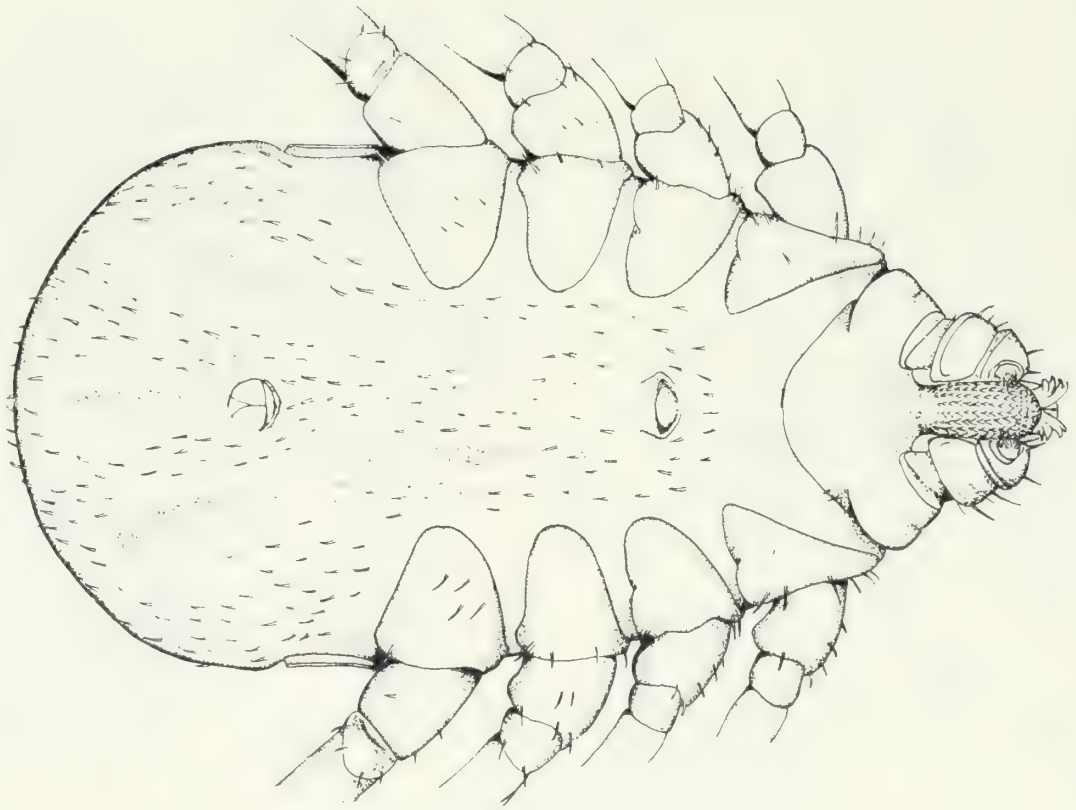
Dorsal

MALE

Ventral







FEMALE

Ventral

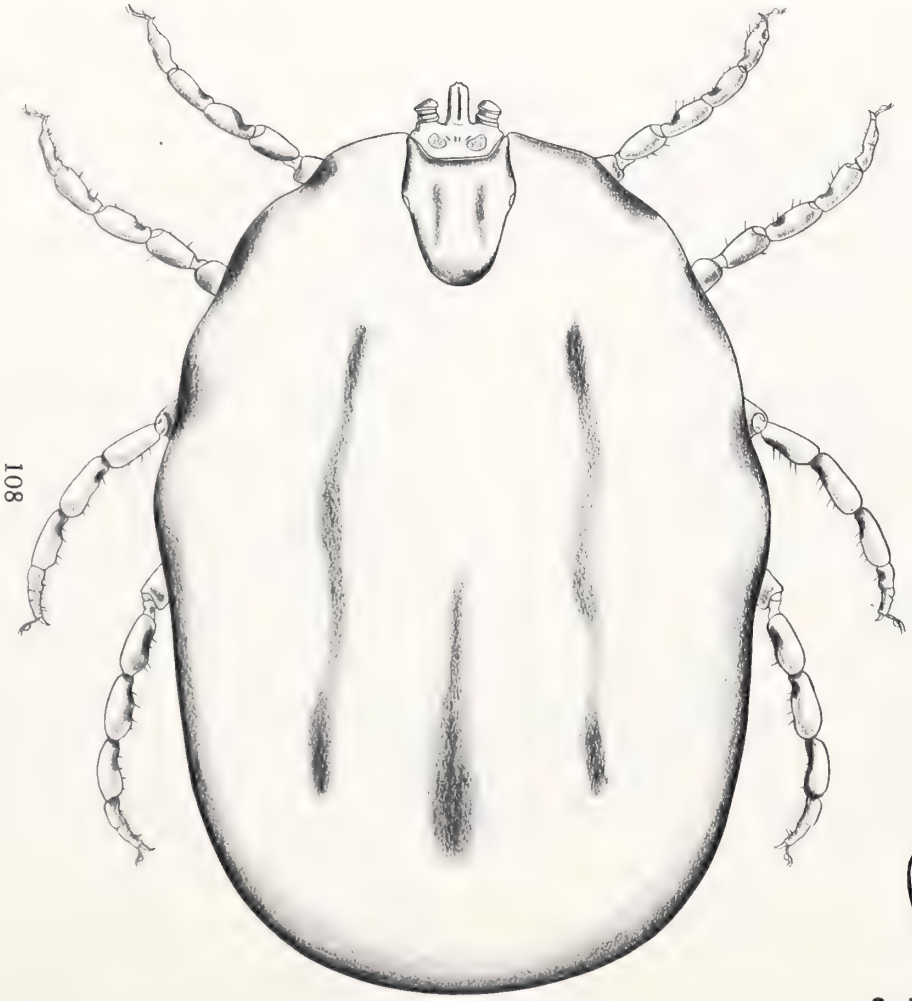
Boophilus microplus

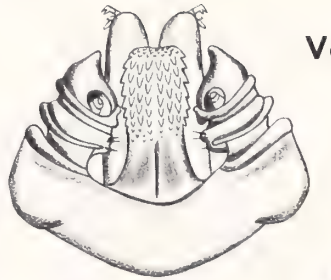
Boophilus microplus

Dorsal

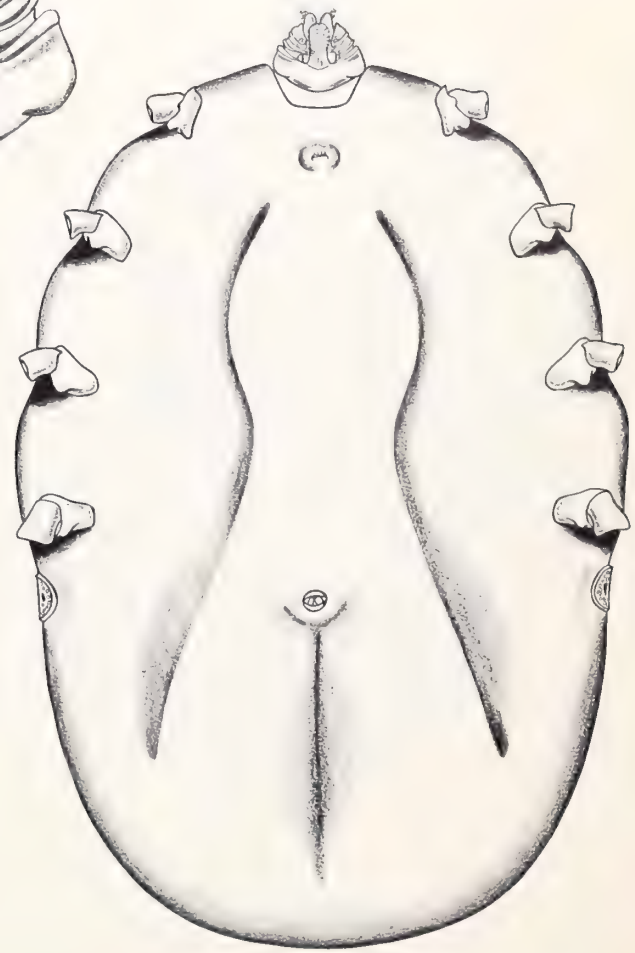
ENGORGED FEMALE

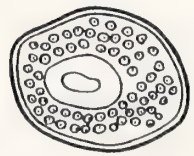
Ventral





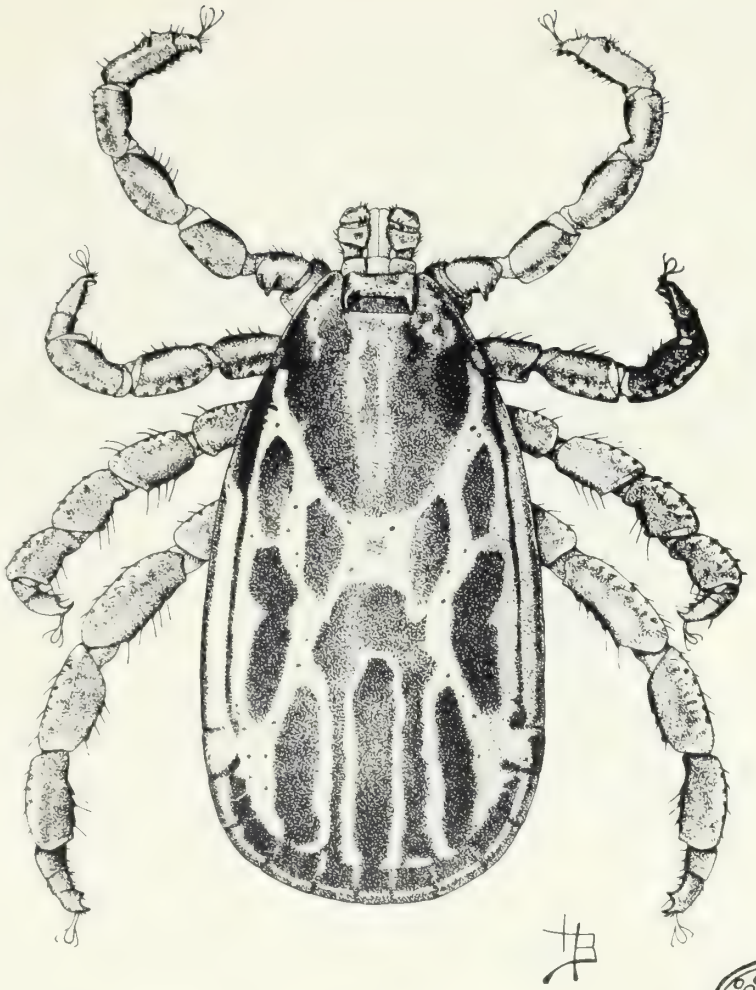
Ventral Hypostome

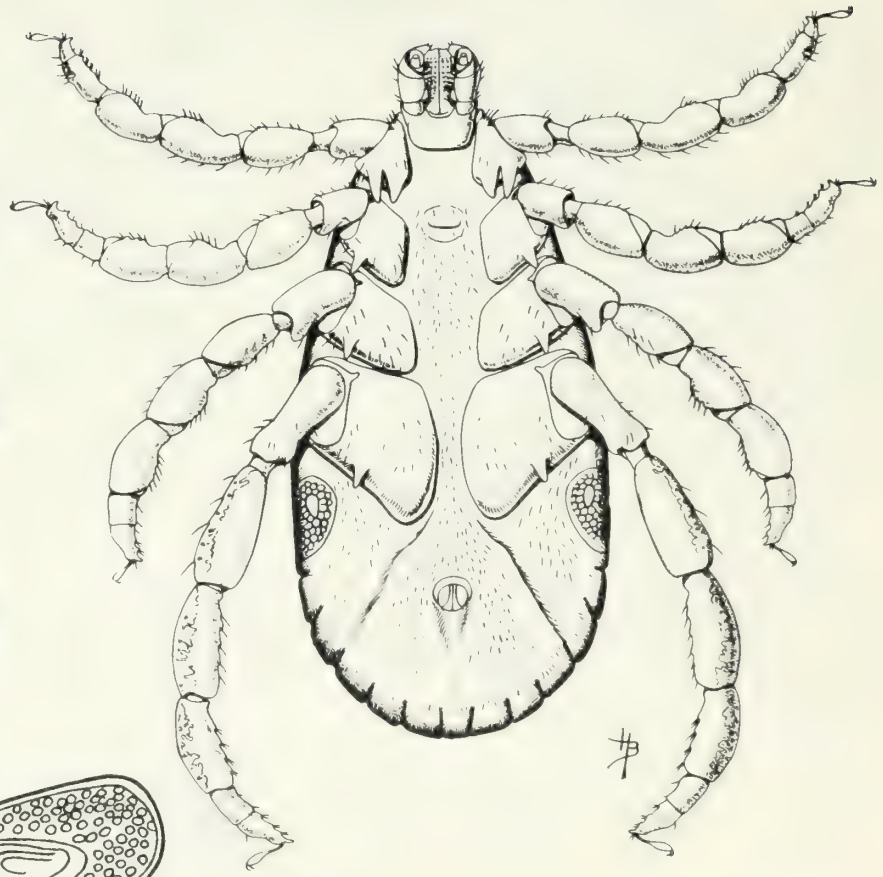




Spiracular Plate

769-385 O-65—9





Spiracular Plate

MALE

Dermacentor albipictus

Dorsal

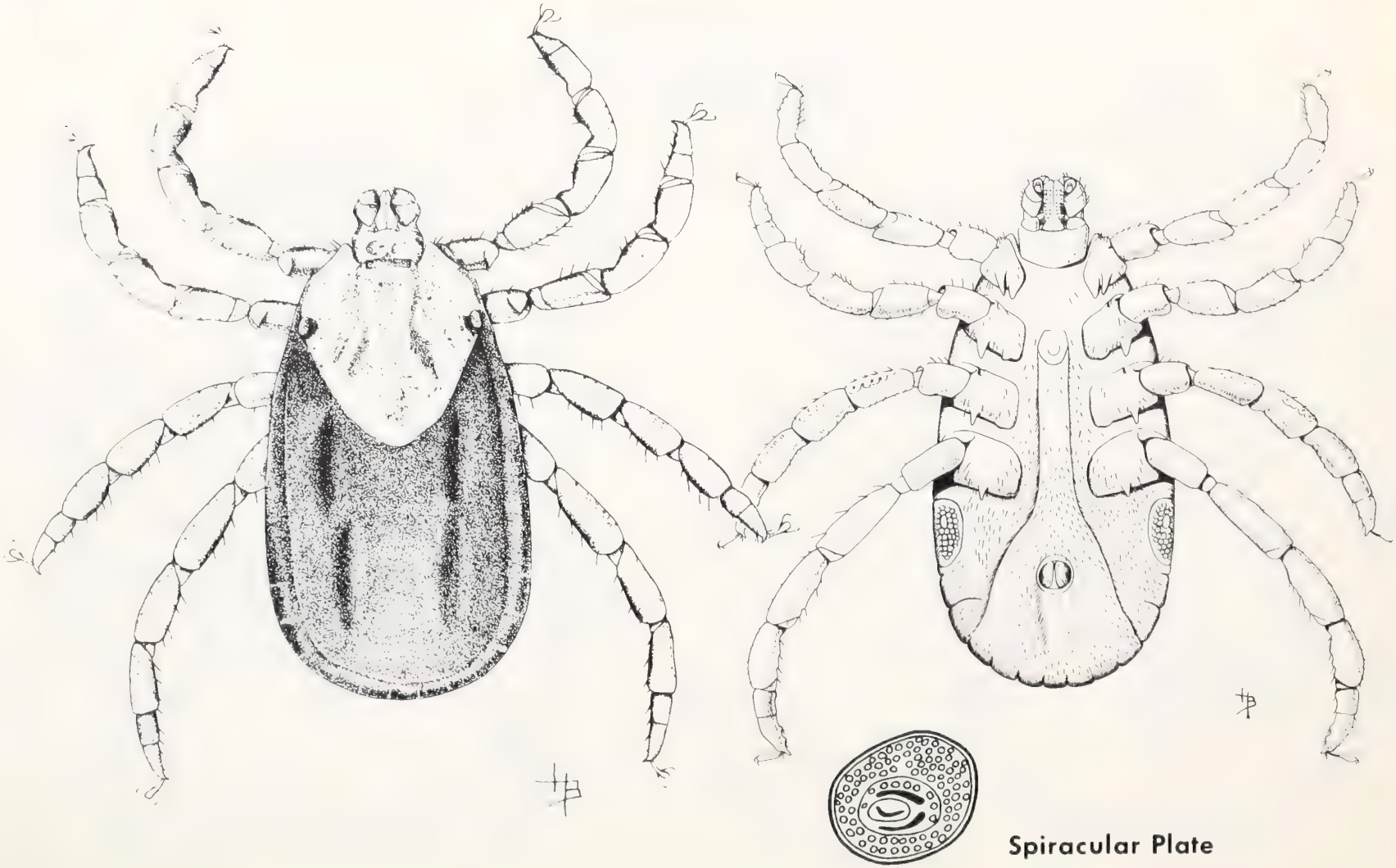
Ventral

Dermacentor albipictus

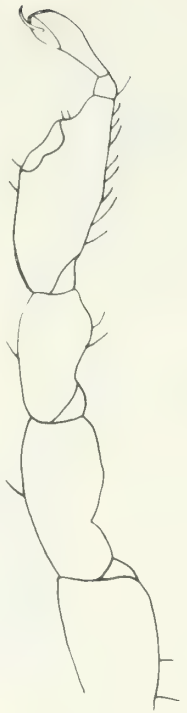
Dorsal

FEMALE

Ventral



Spiracular Plate



Spiracular Plate

Dorsal

NYMPH

Ventral

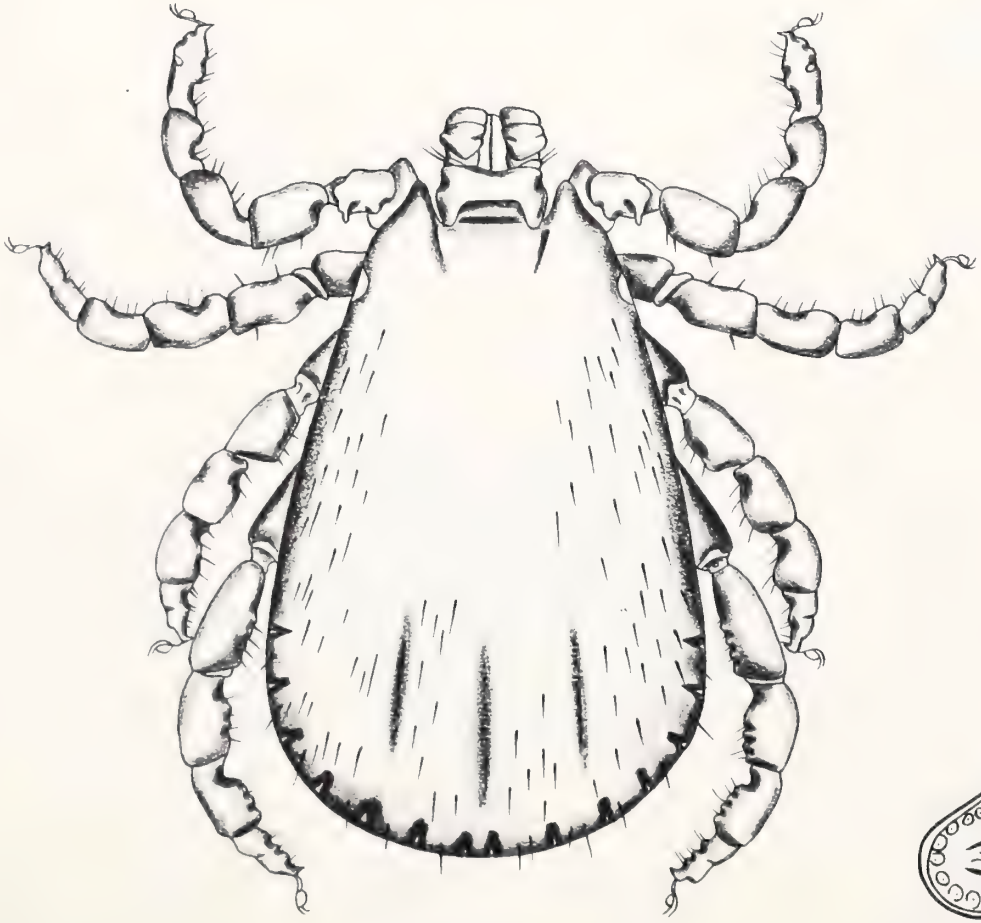
Dermacentor albipictus

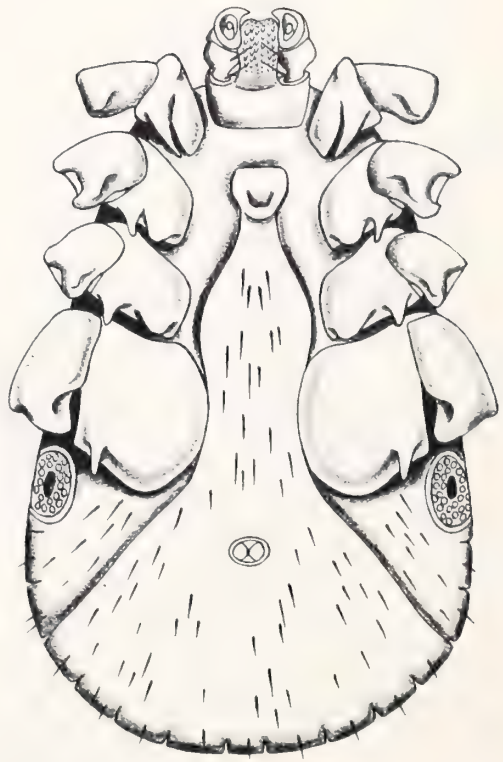
Dermacentor nigrolineatus

Dorsal

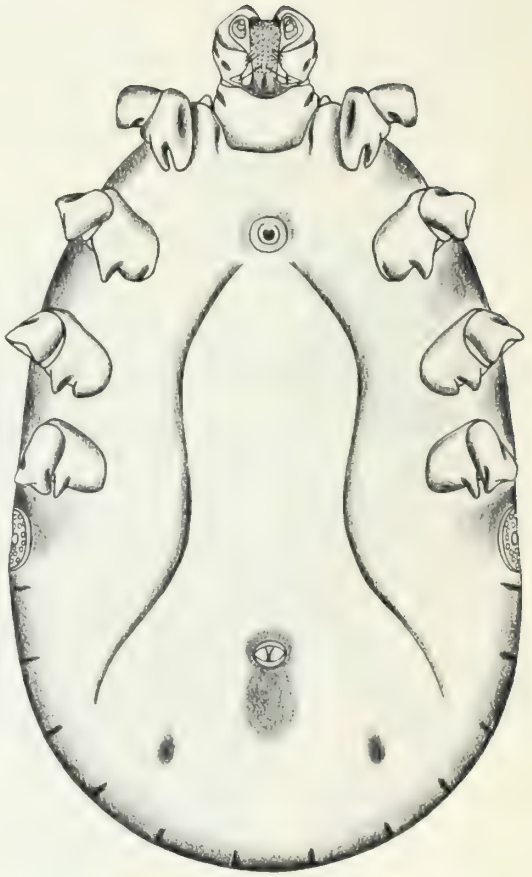
MALE

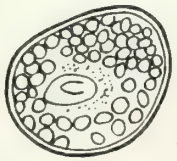
Ventral





Spiracular Plate





Spiracular Plate

Dorsal

FEMALE

Ventral

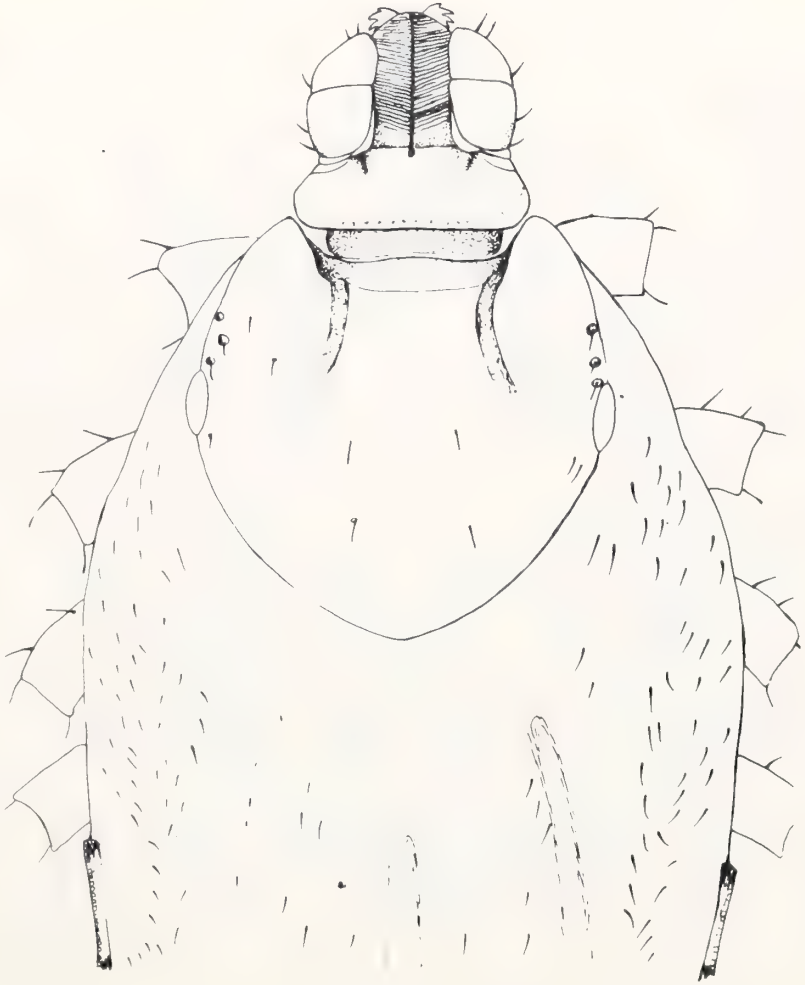
Dermacentor nigrolineatus

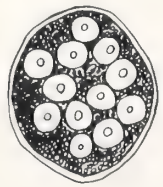
Dermacentor nigrolineatus

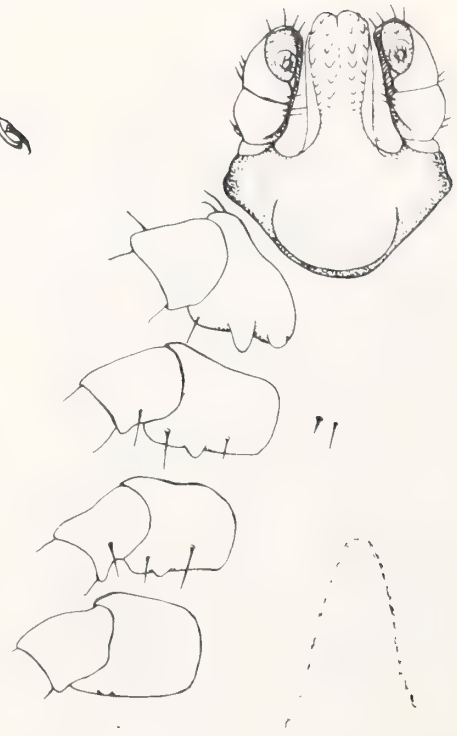
Dorsal

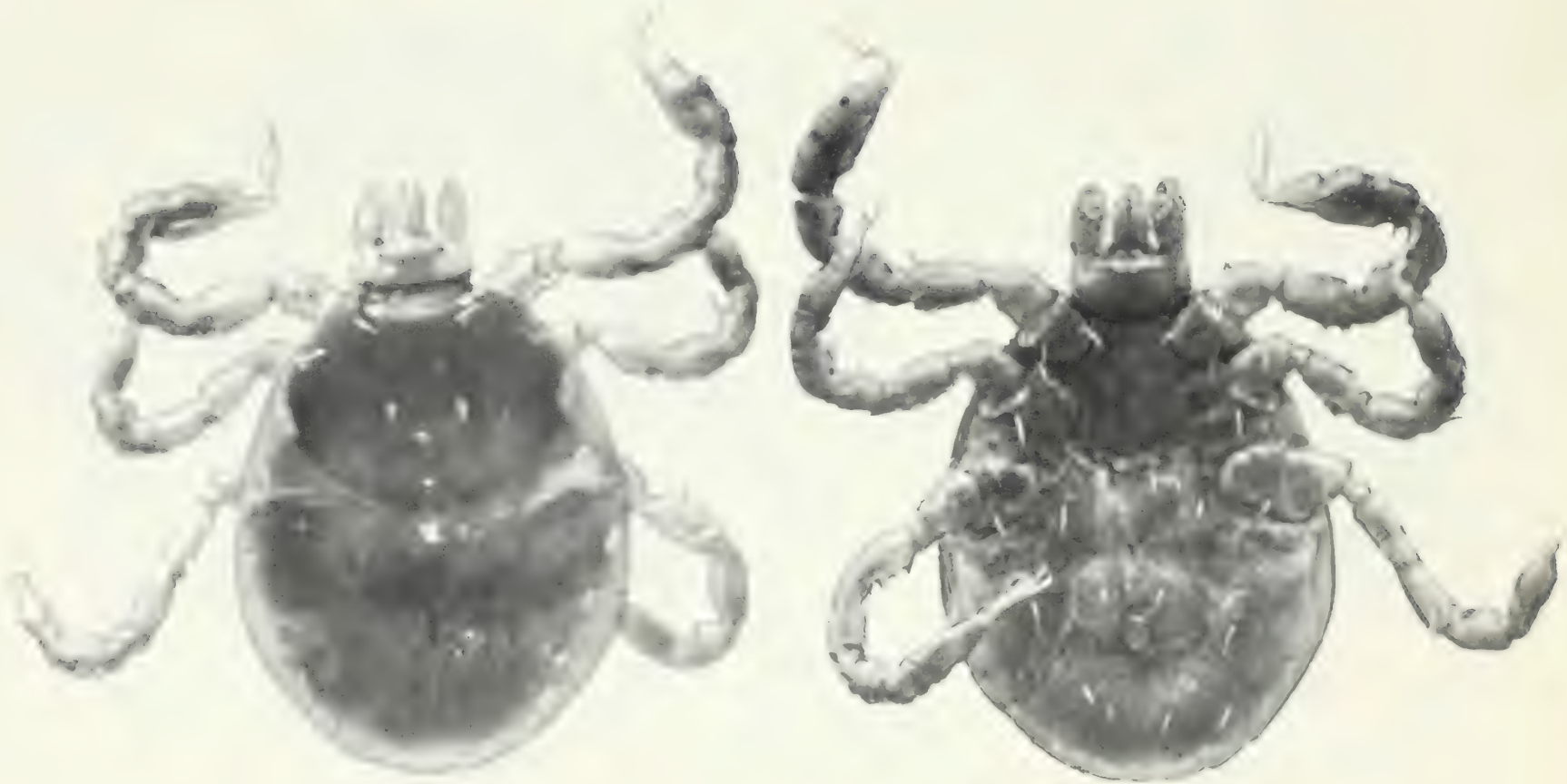
NYMPH

Ventral









Dorsal

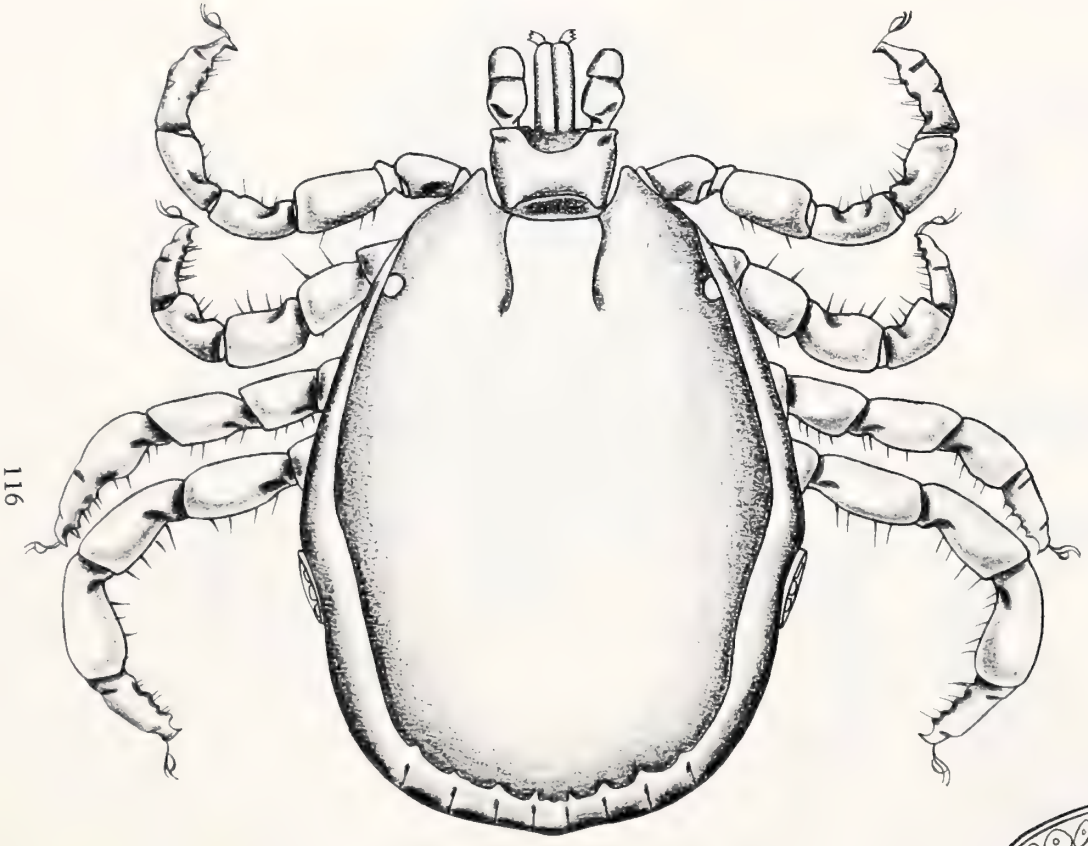
LARVA

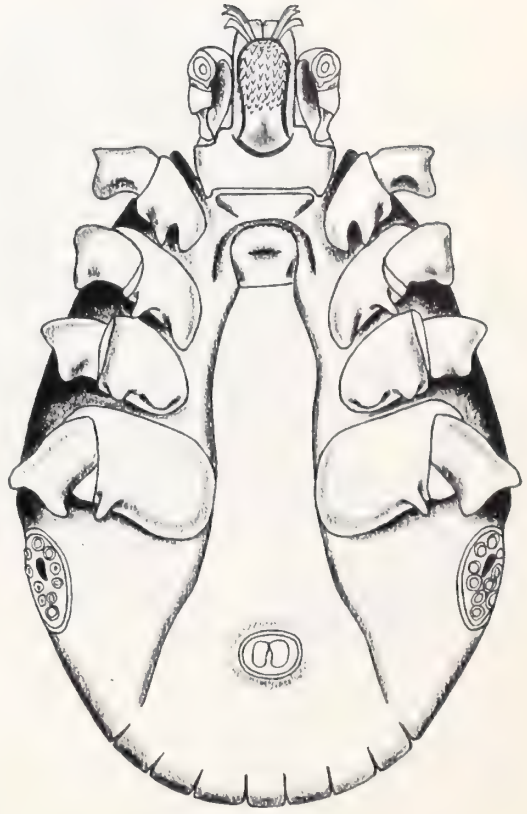
Ventral

Dermacentor nigrolineatus

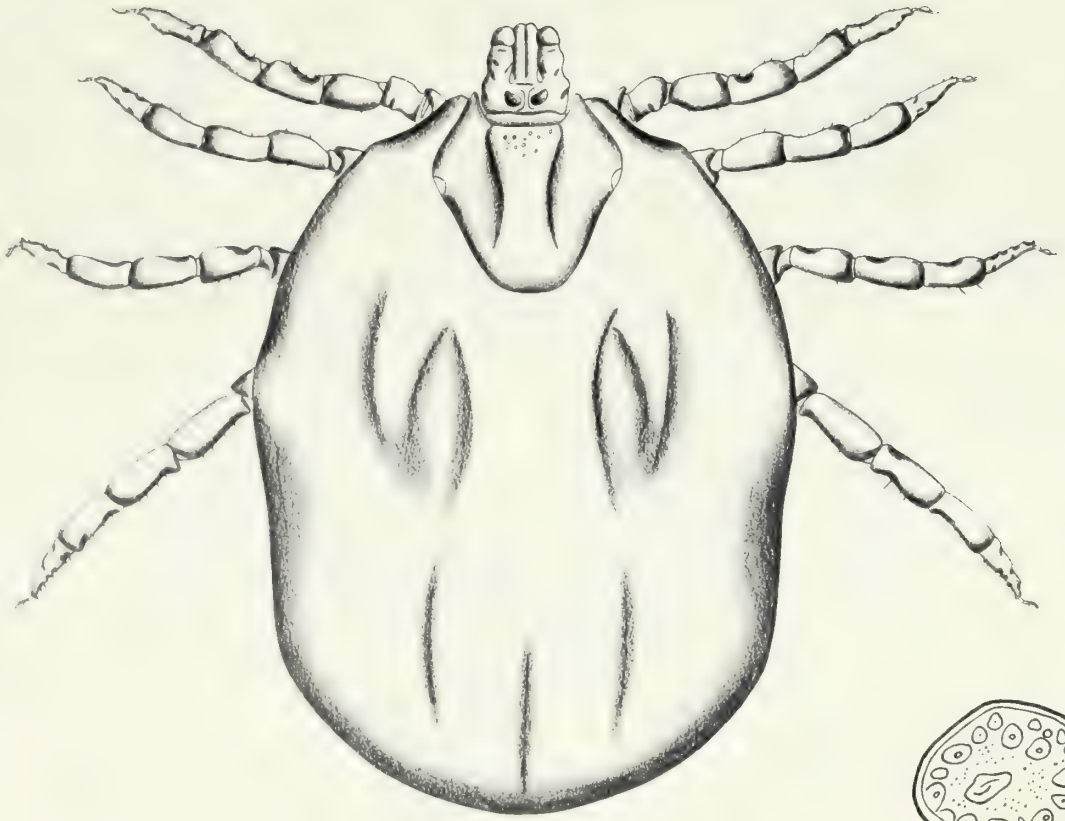
Dermacentor nitens

Dorsal **MALE** Ventral





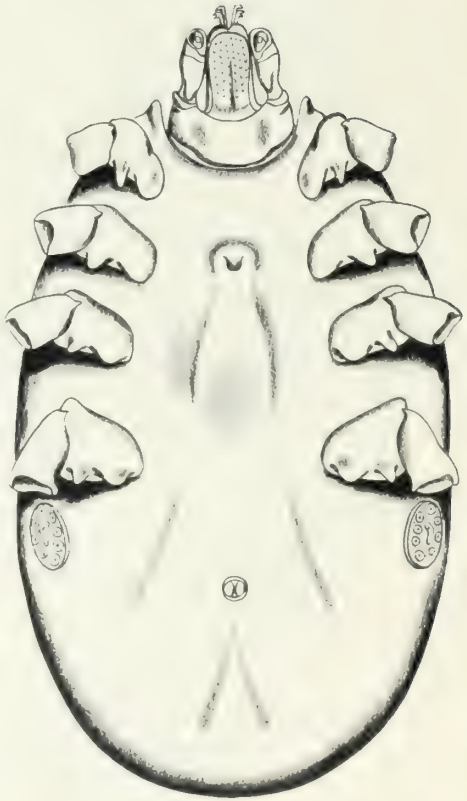
Spiracular Plate



Spiracular Plate

Dorsal

FEMALE



Ventral

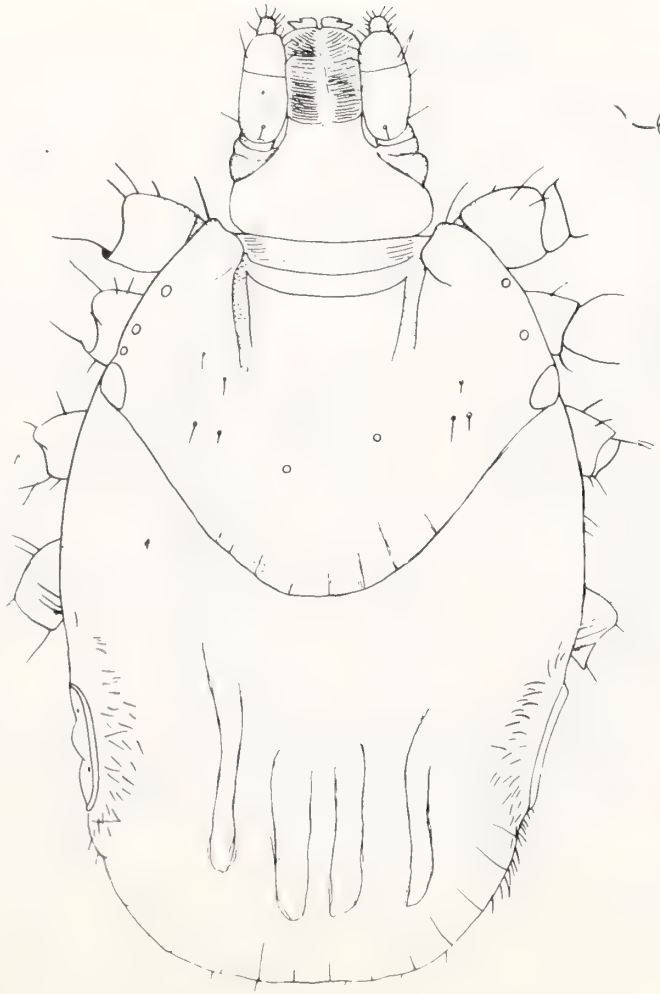
Dermacentor nitens

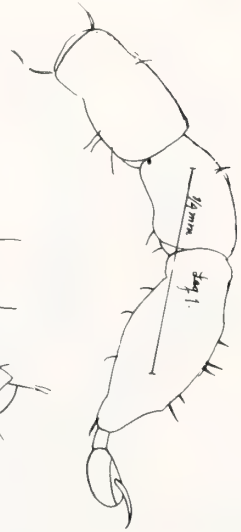
Dermacentor nitens

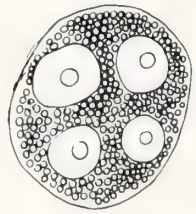
Dorsal

NYMPH

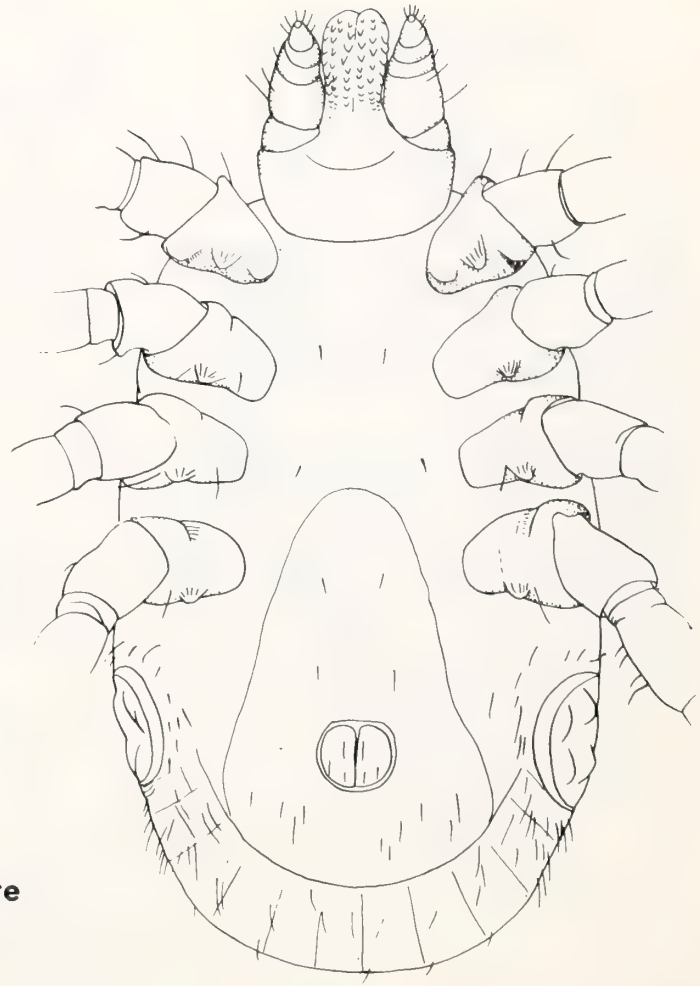
Ventral

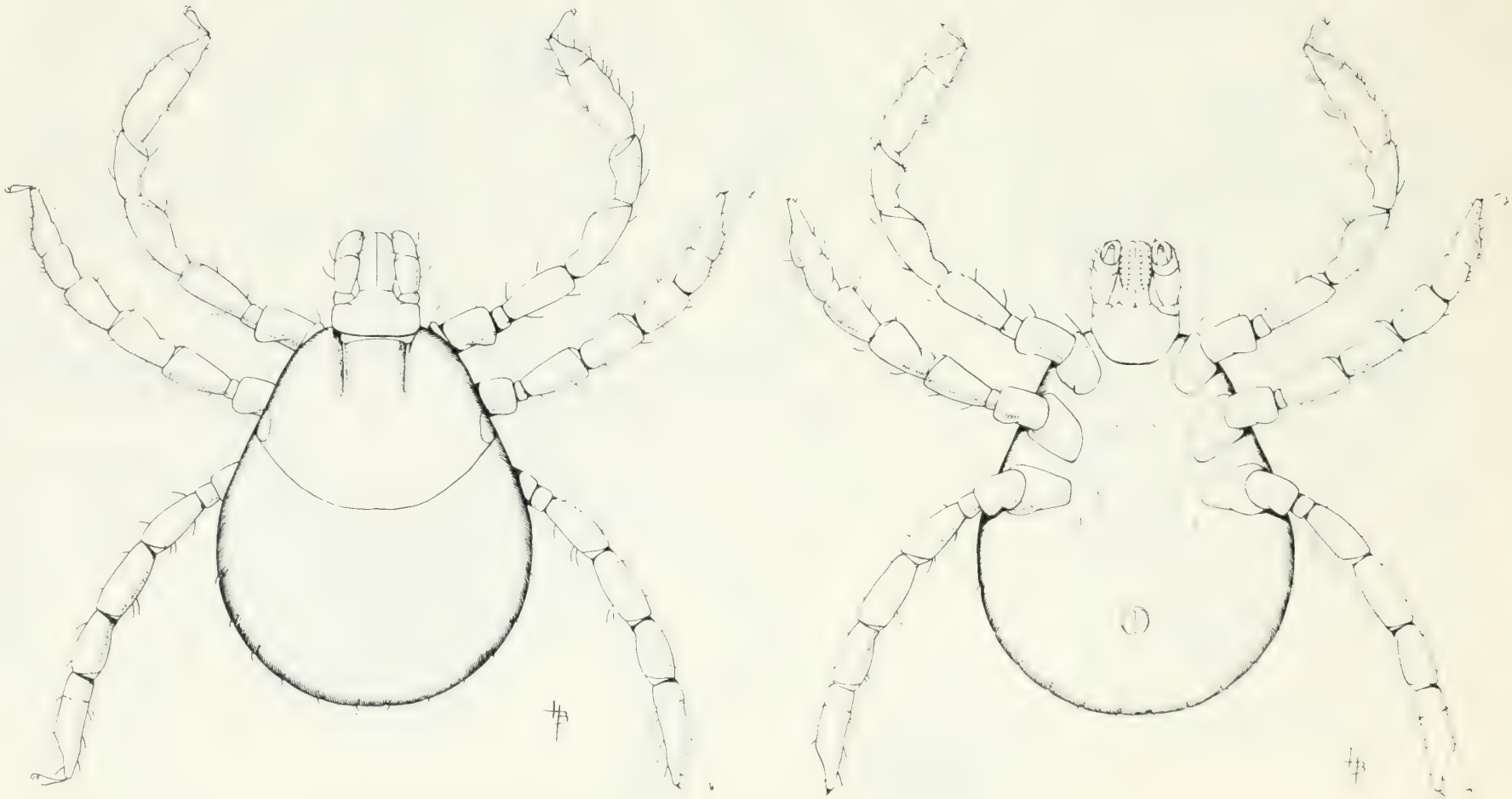






Spiracular Plate





Dorsal

LARVA

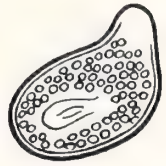
Ventral

Dermacentor nitens

Dermacentor occidentalis

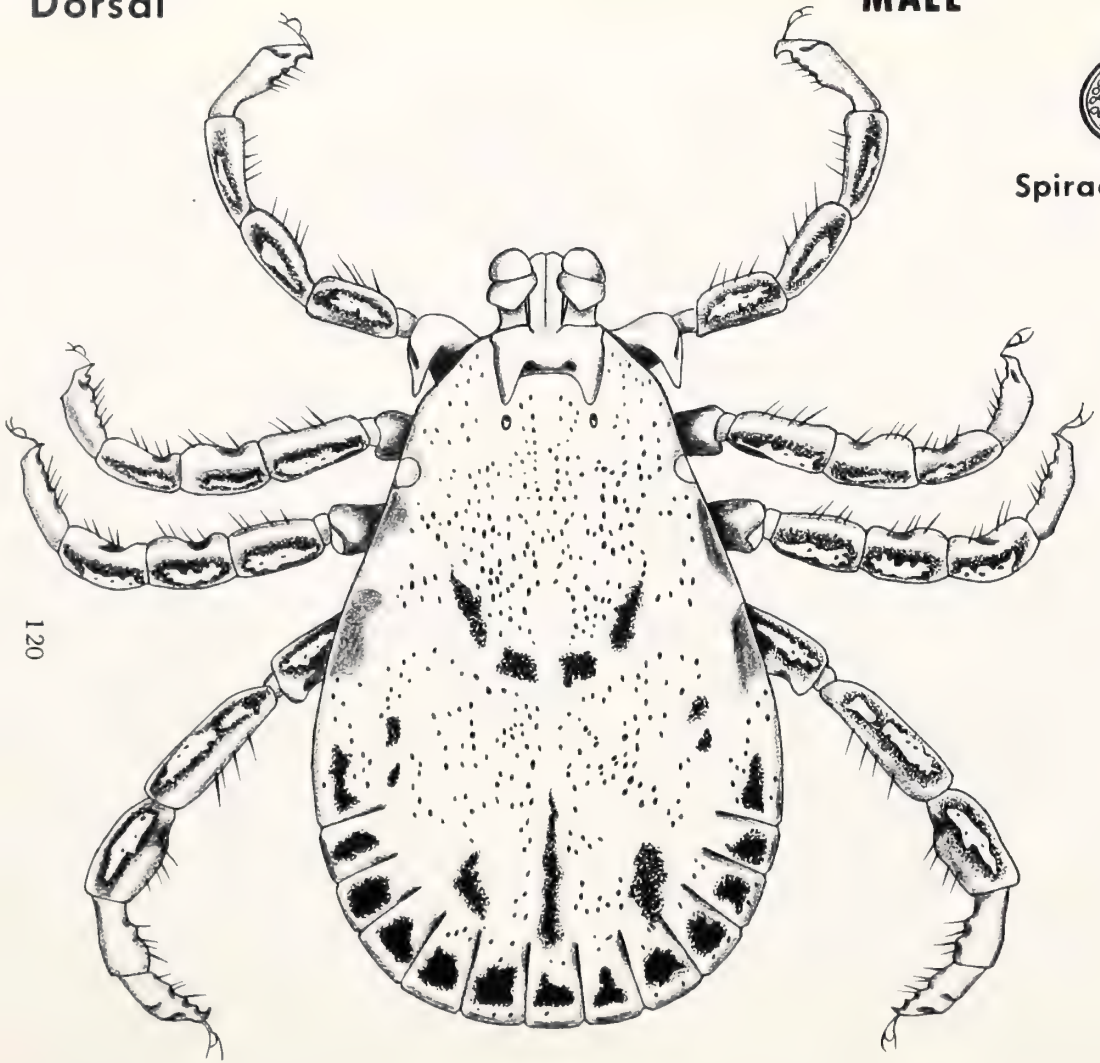
Dorsal

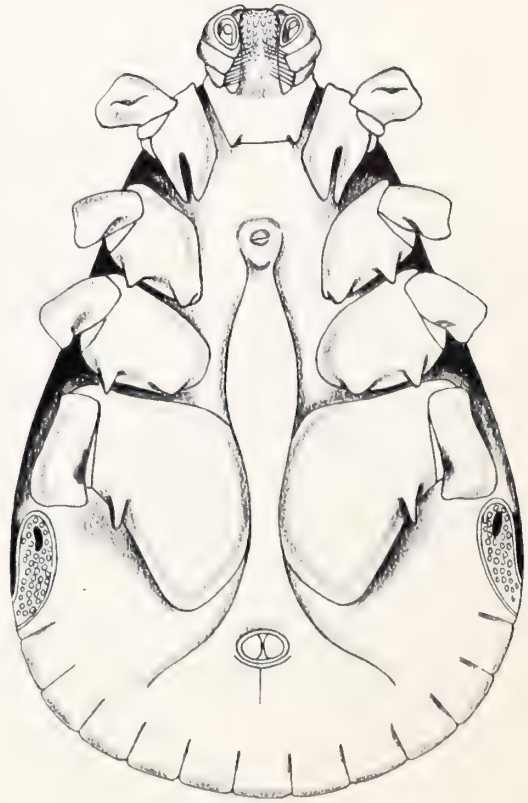
MALE



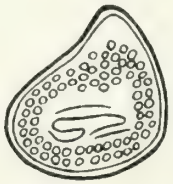
Spiracular Plate

Ventral



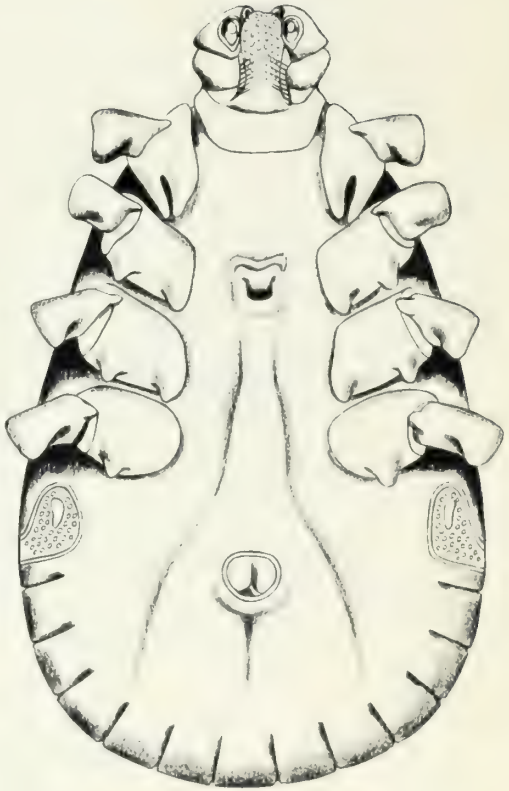


Dorsal



Spiracular Plate

FEMALE



Ventral

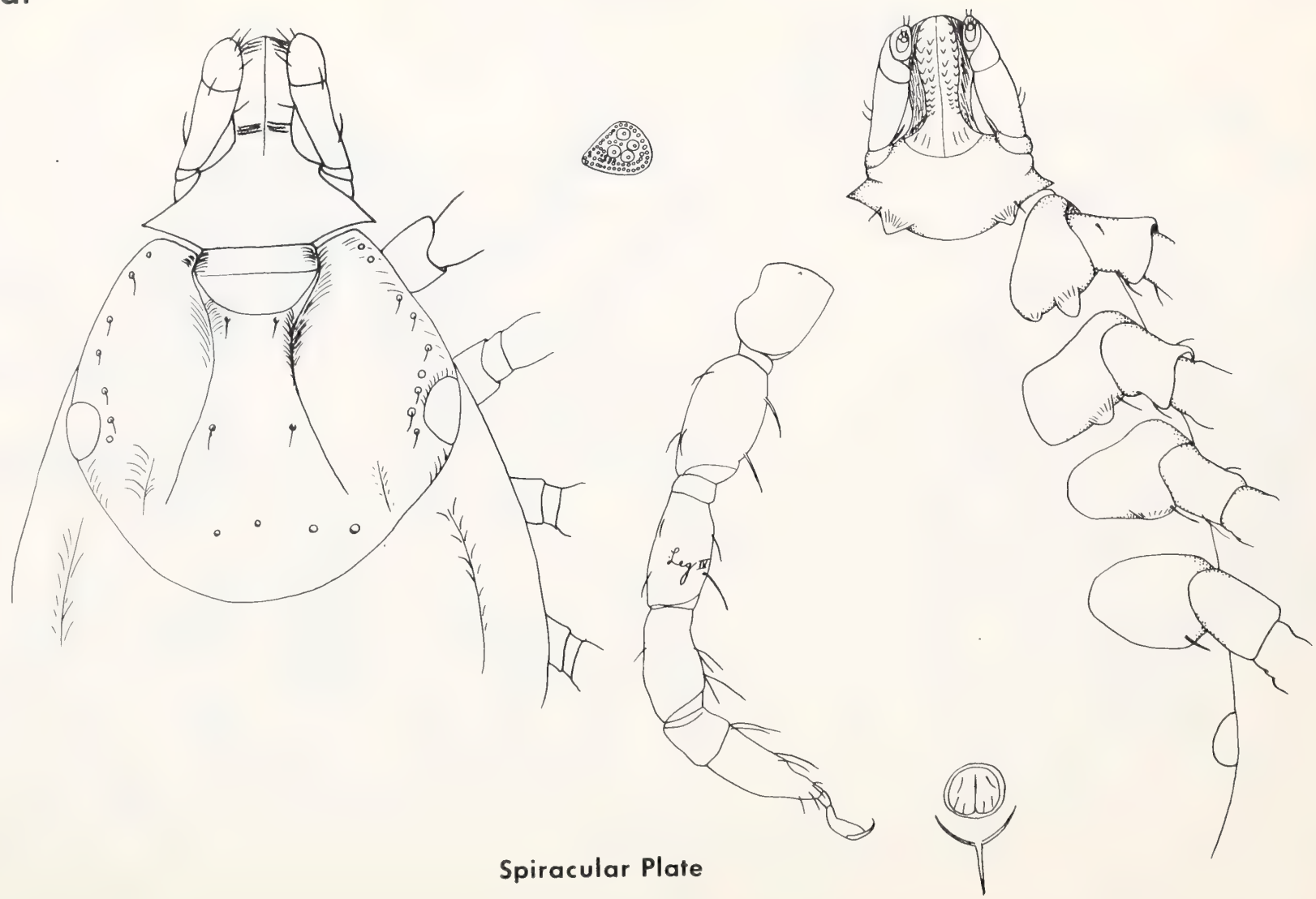
Dermacentor occidentalis

Dermacentor occidentalis

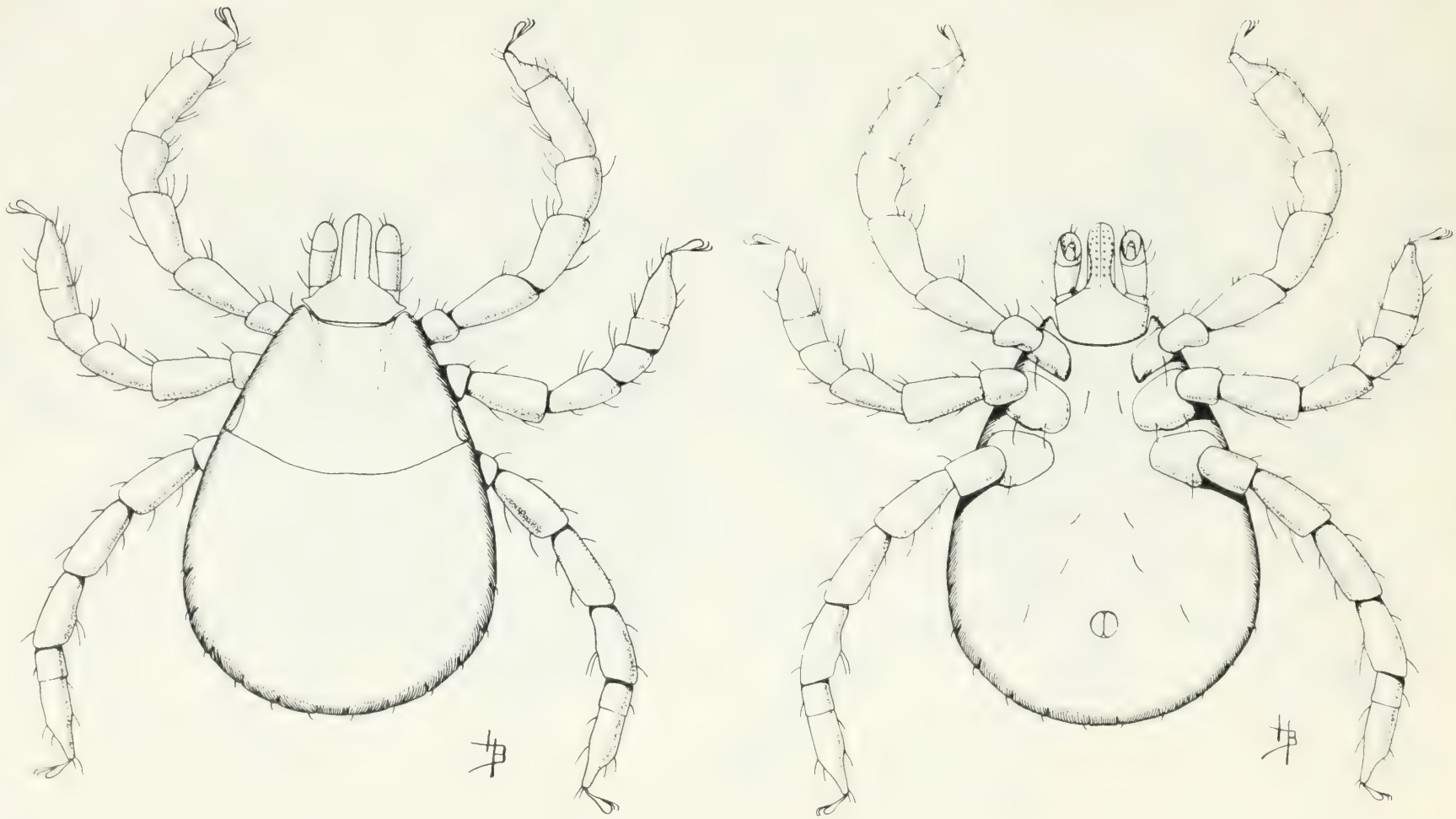
NYMPH

Dorsal

Ventral



Spiracular Plate



Dorsal

LARVA

Ventral

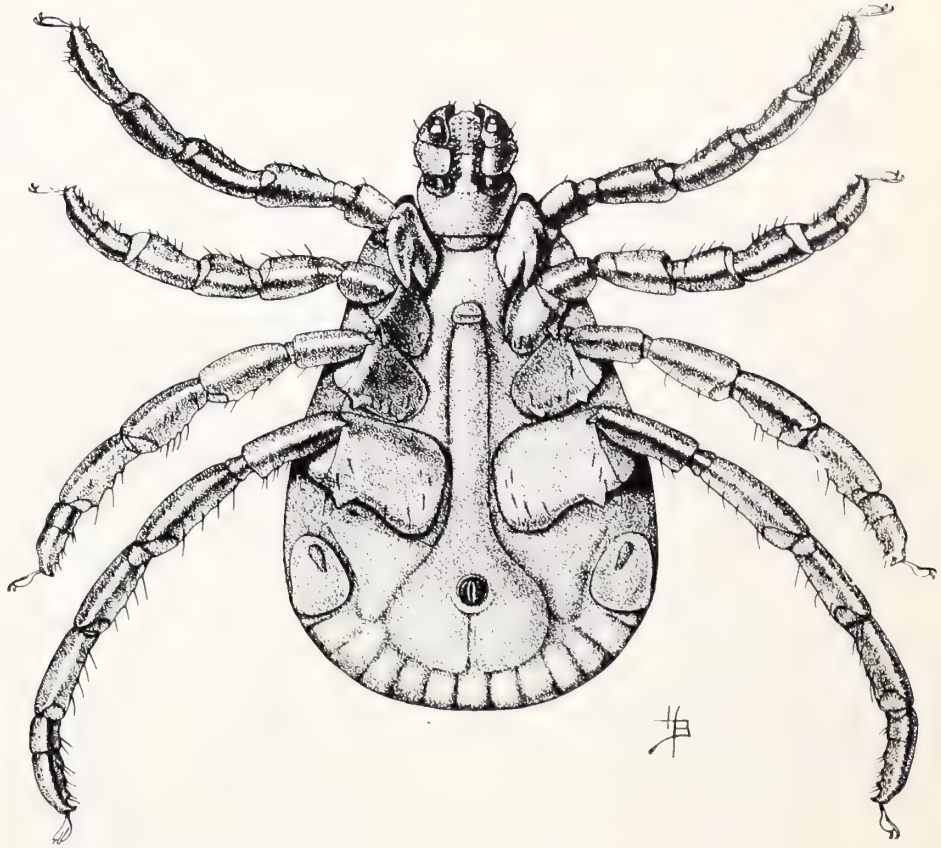
Dermacentor occidentalis

Dermacentor variabilis

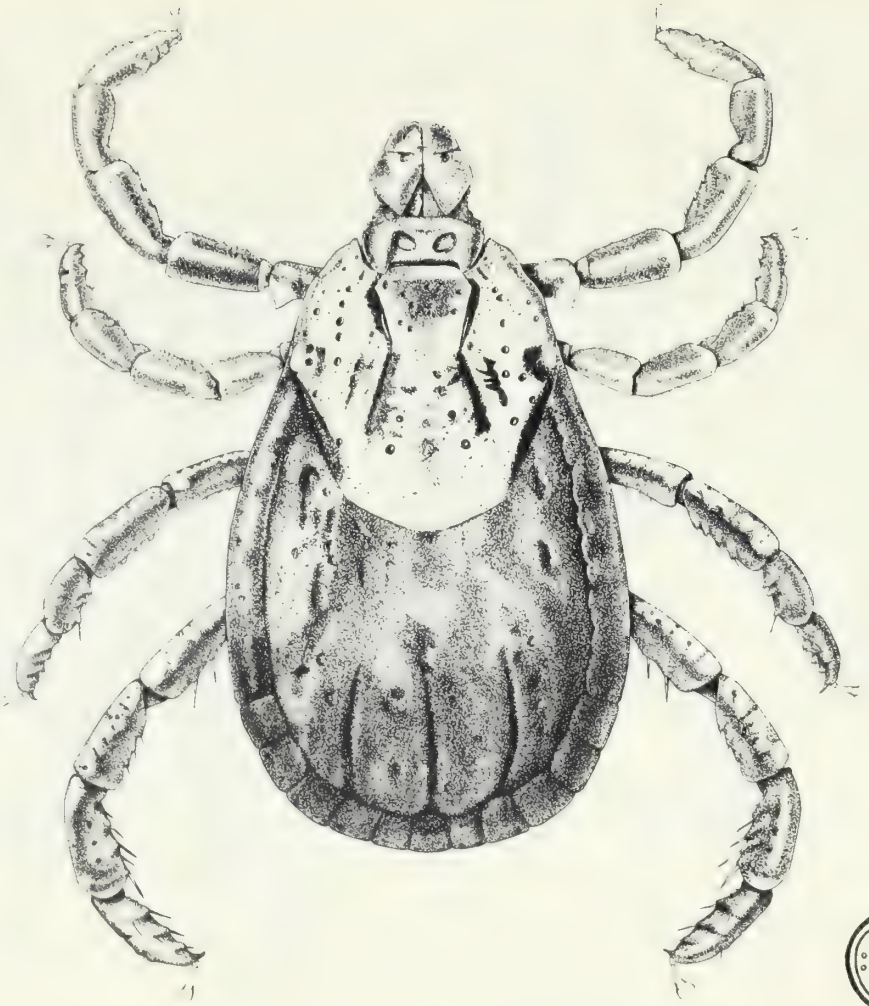
Dorsal

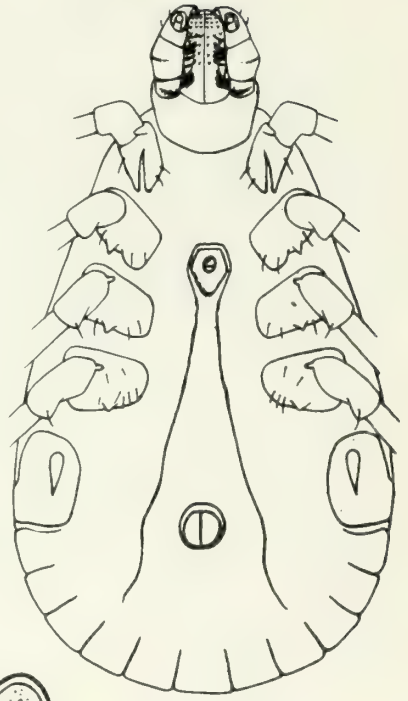
MALE

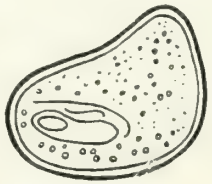
Ventral



Spiracular Plate







Dorsal

FEMALE

Spiracular Plate

Ventral

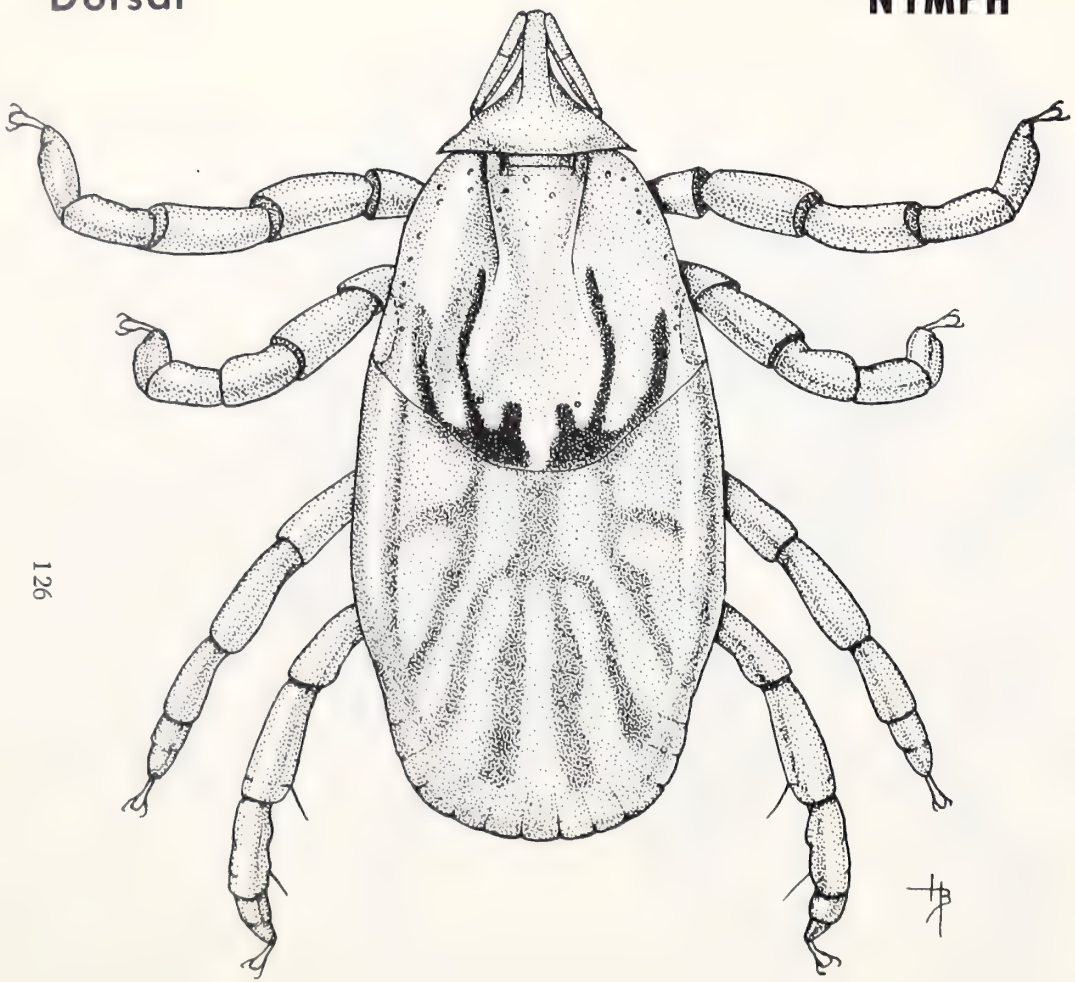
Dermacentor variabilis

Dermacentor variabilis

Dorsal

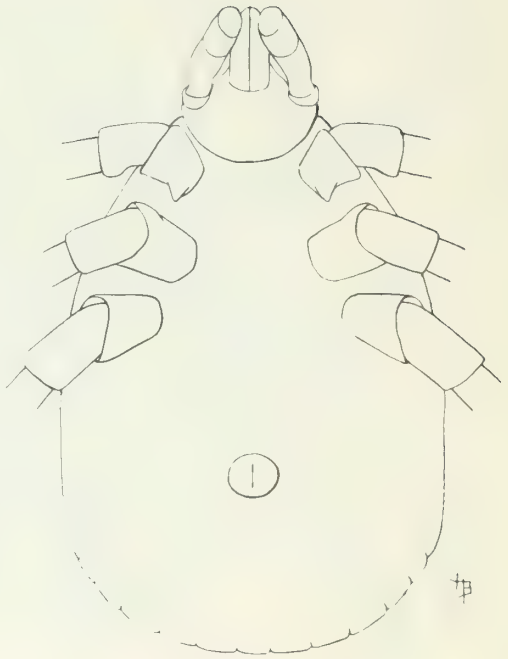
NYMPH

Ventral



Spiracular Plate

769-385 O-65—10



Dorsal

LARVA

Ventral

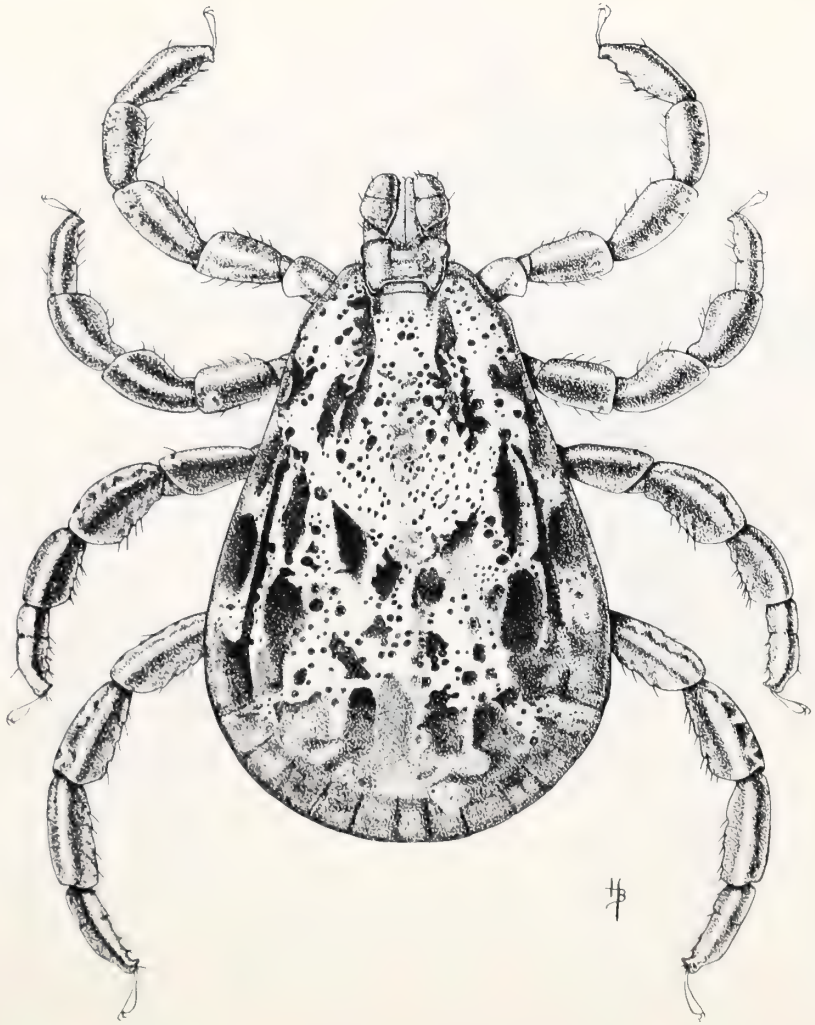
Dermacentor variabilis

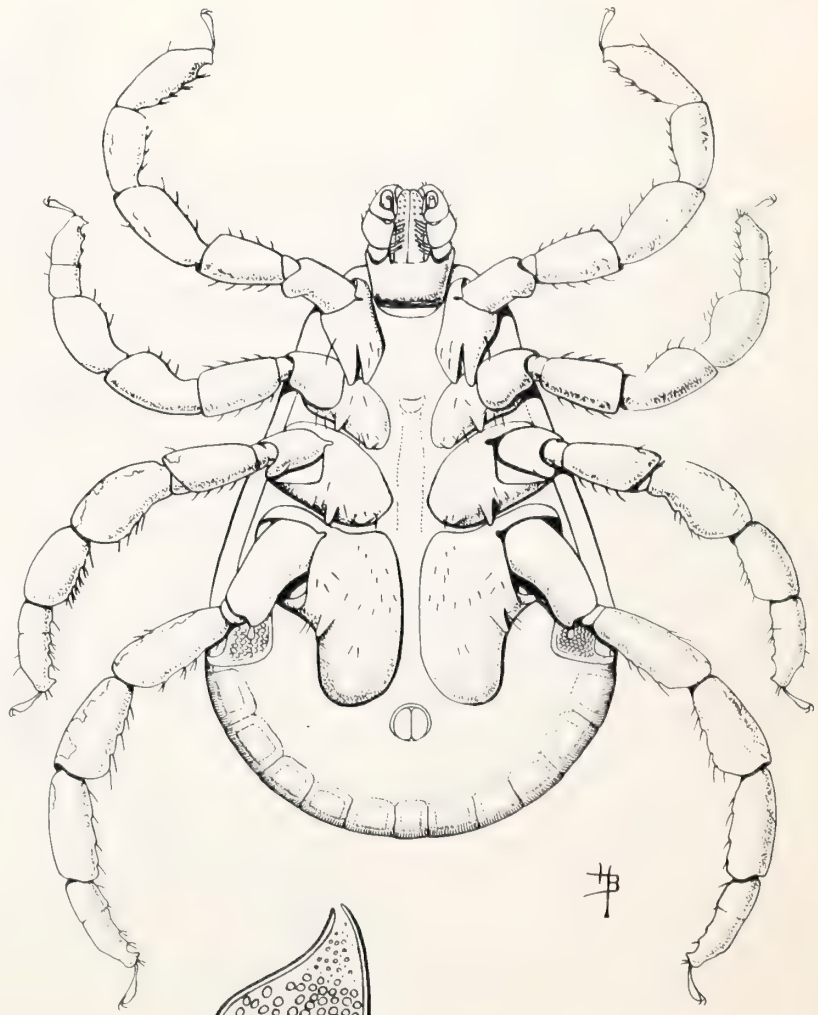
Dermacentor venustus

Dorsal

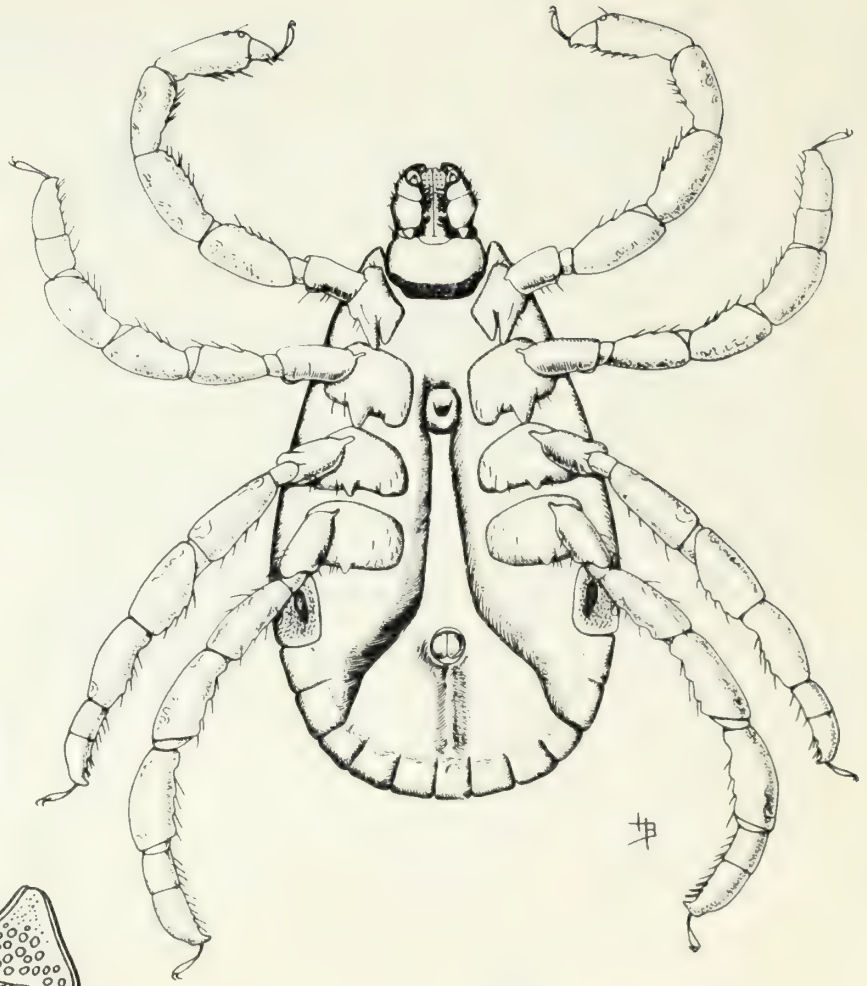
MALE

Ventral





Spiracular Plate



Spiracular Plate

Dorsal

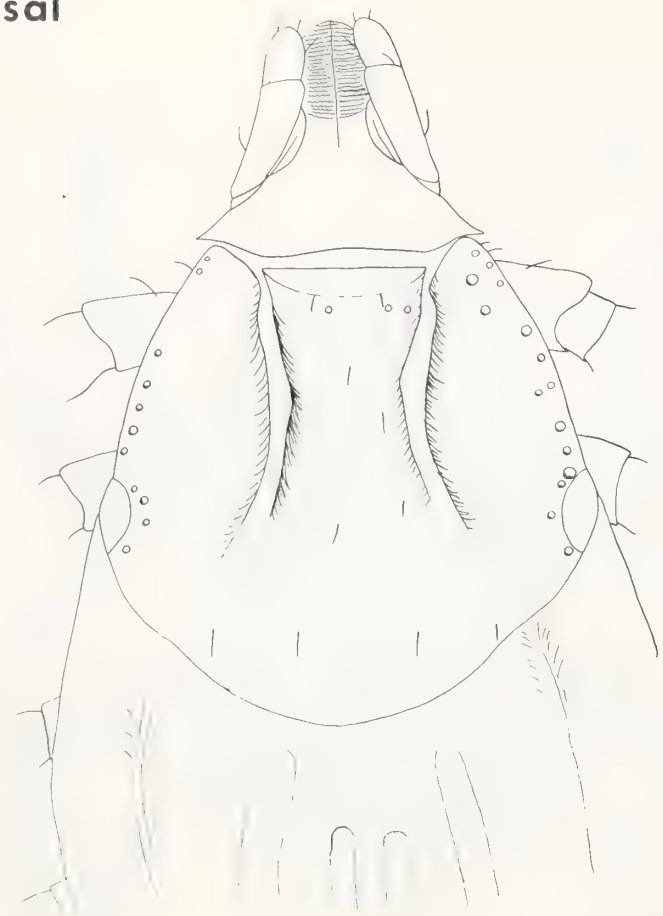
Ventral

FEMALE

Dermacentor venustus

Dermacentor venustus

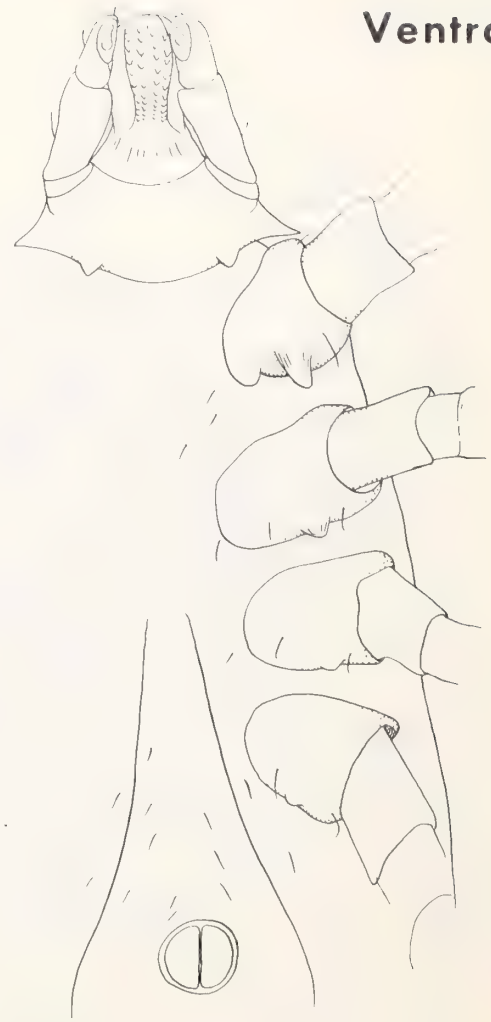
Dorsal

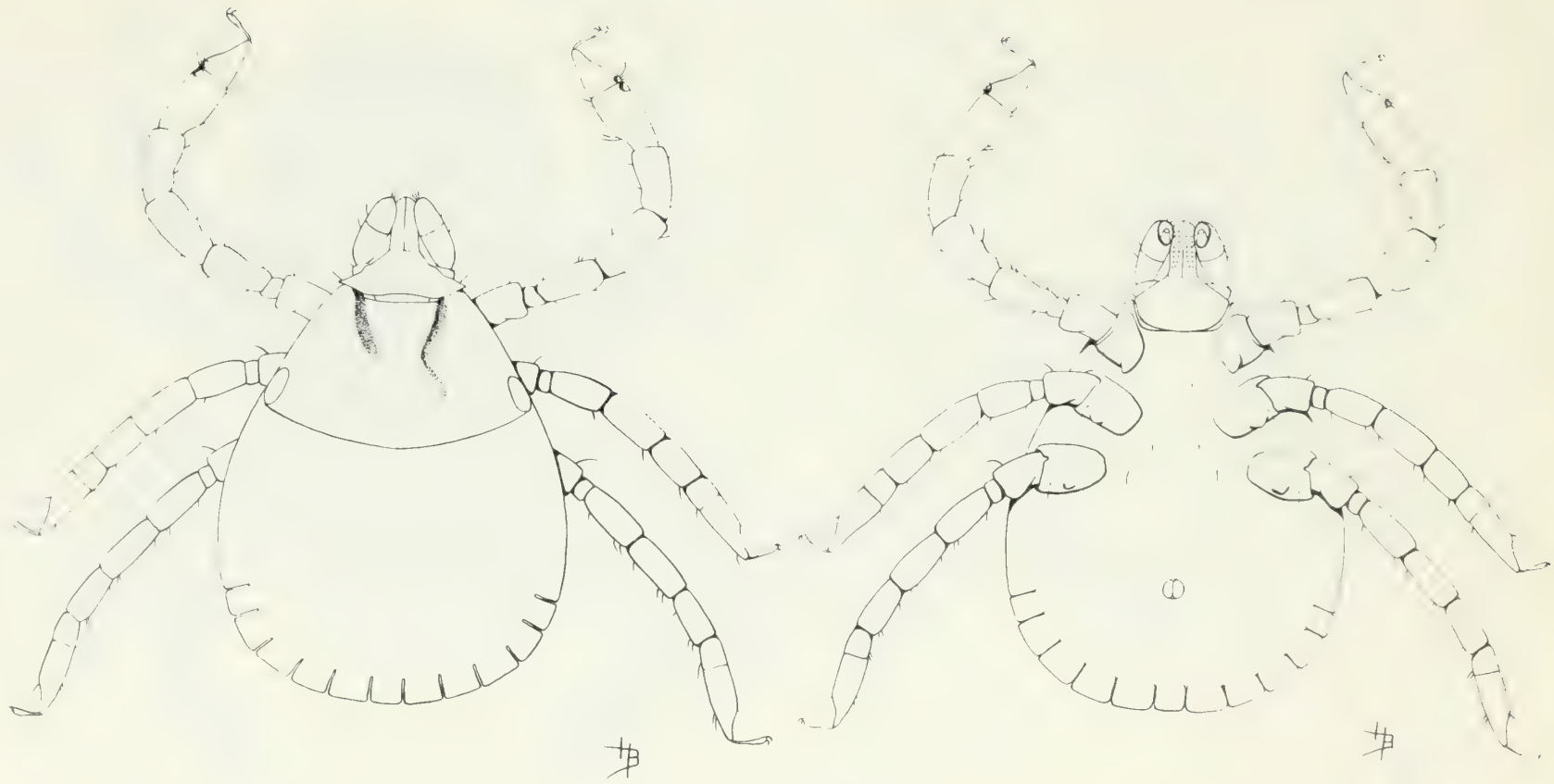


NYMPH

Spiracular Plate

Ventral





Dorsal

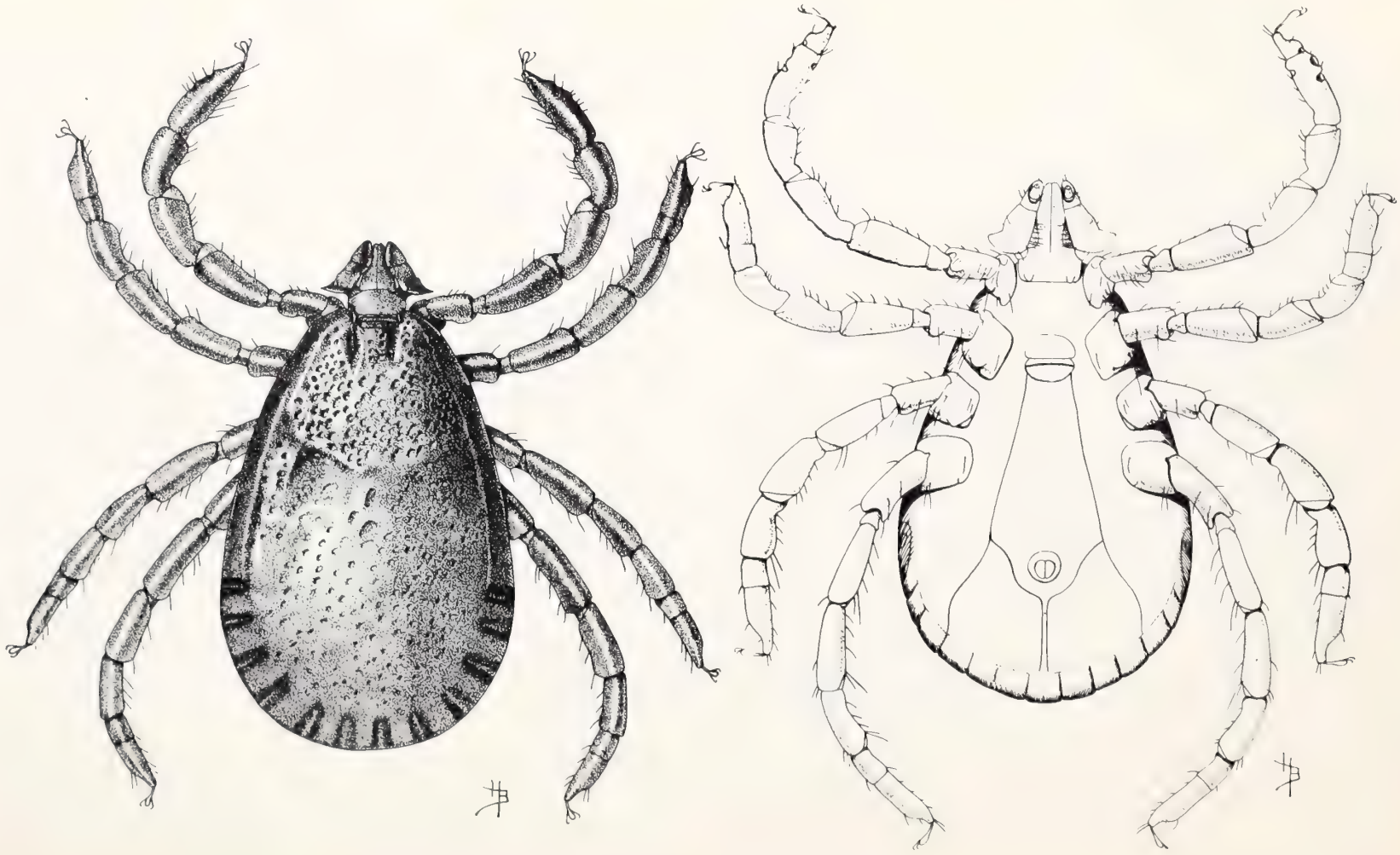
LARVA

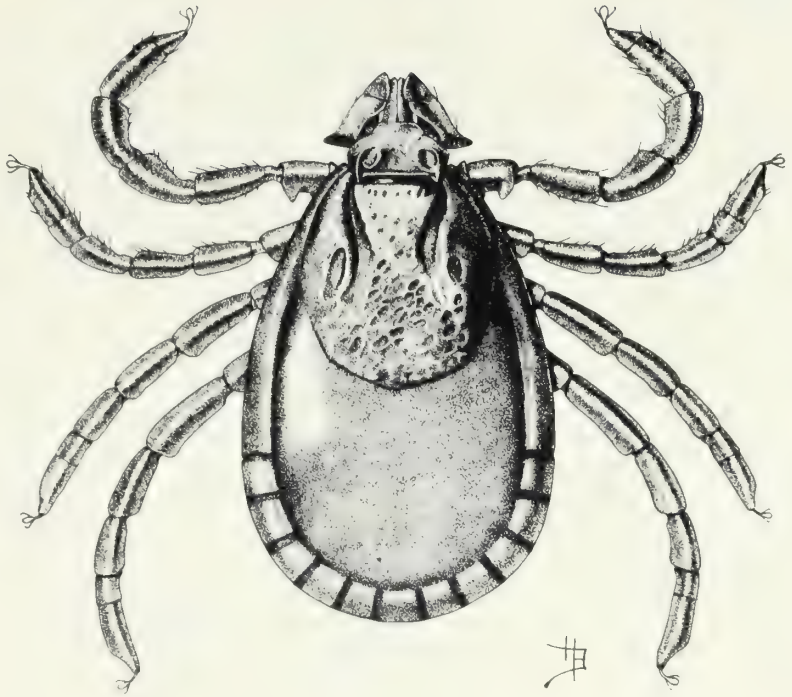
Ventral

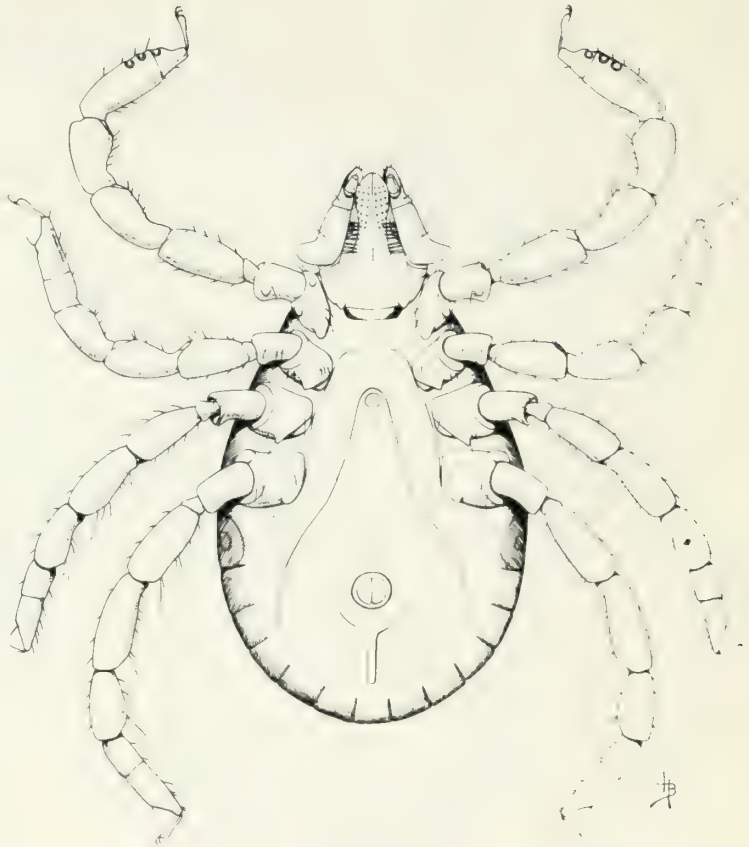
Dermacentor venustus

Haemaphysalis leporispalustris

Dorsal **MALE** Ventral







Dorsal

FEMALE

Ventral

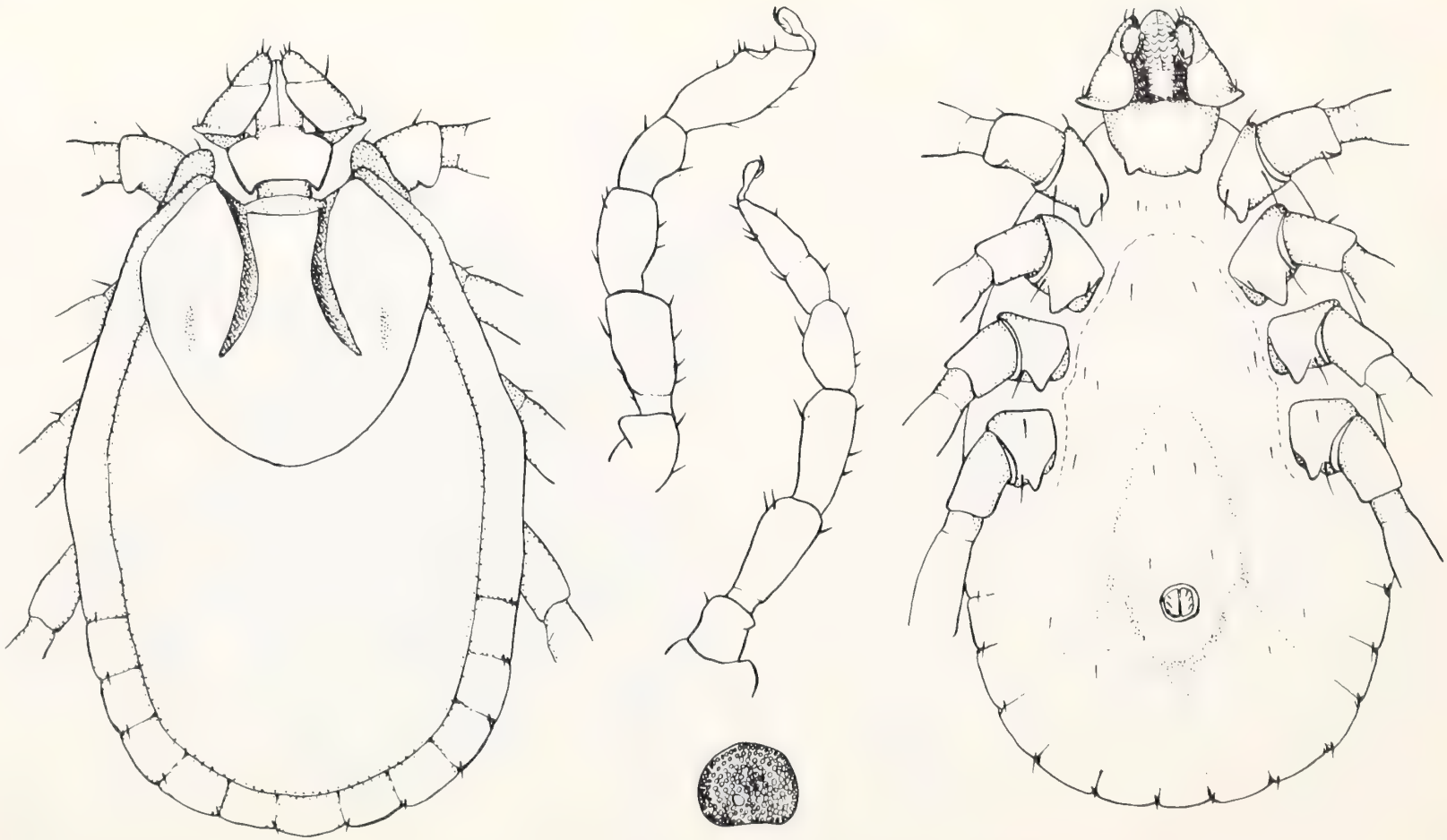
Haemaphysalis leporispalustris

Haemaphysalis leporispalustris

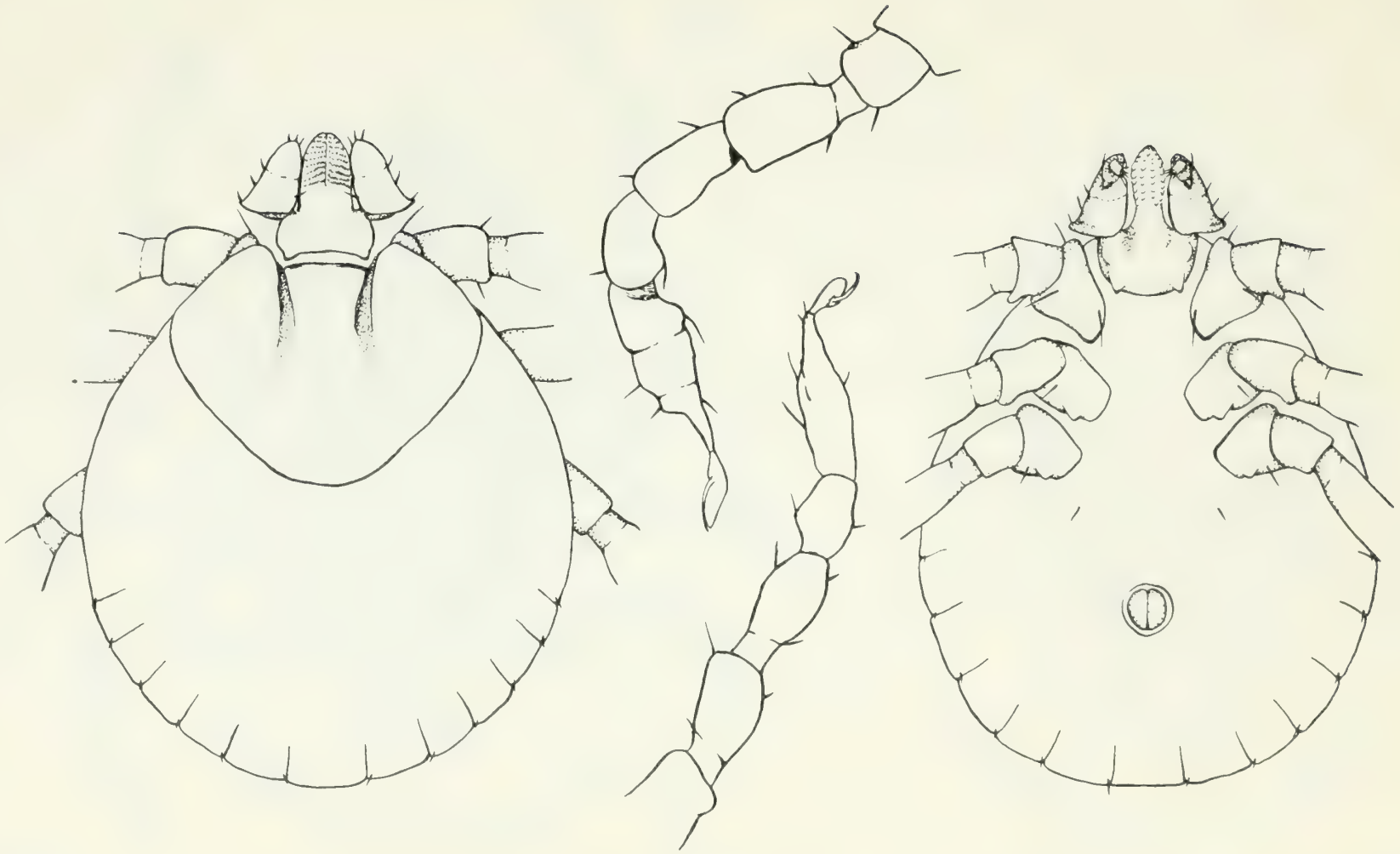
Dorsal

NYMPH

Ventral



Spiracular Plate



Dorsal

LARVA

Ventral

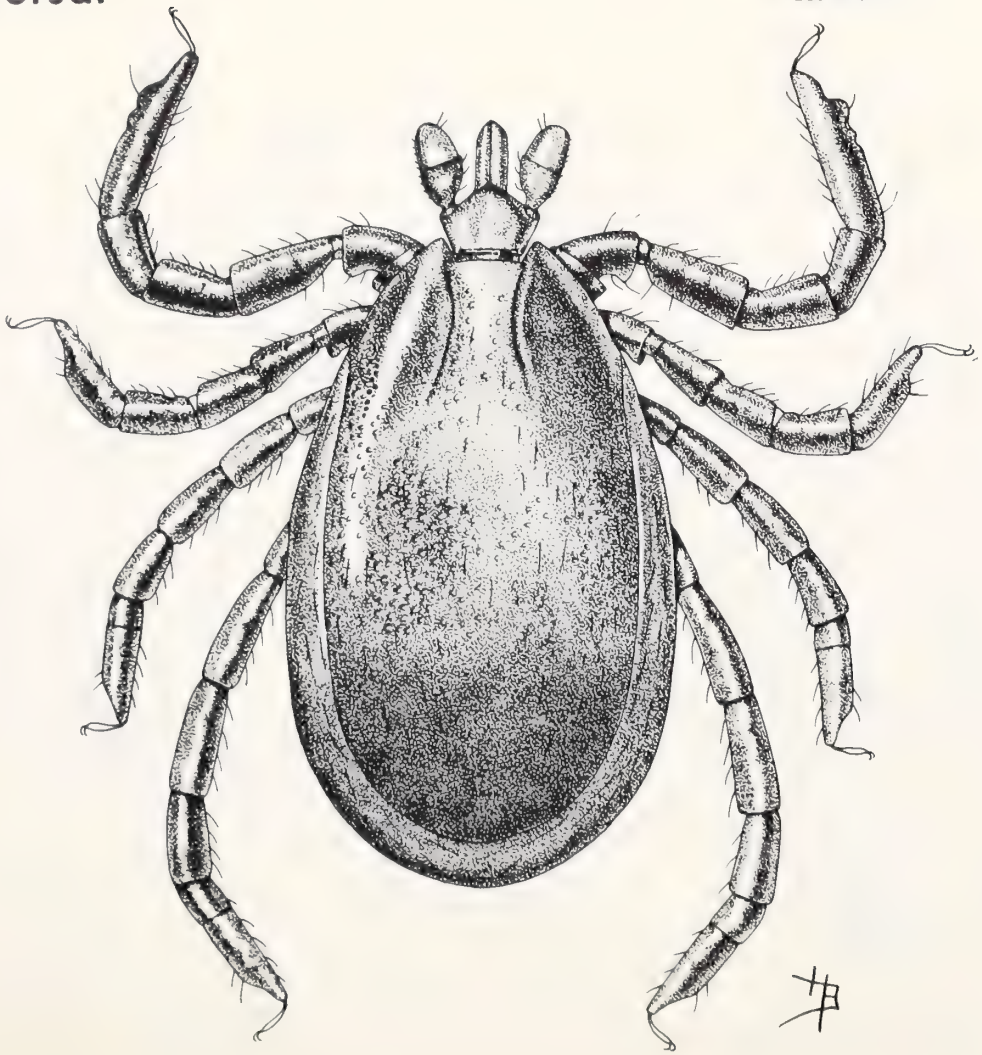
Haemaphysalis leporispalustris

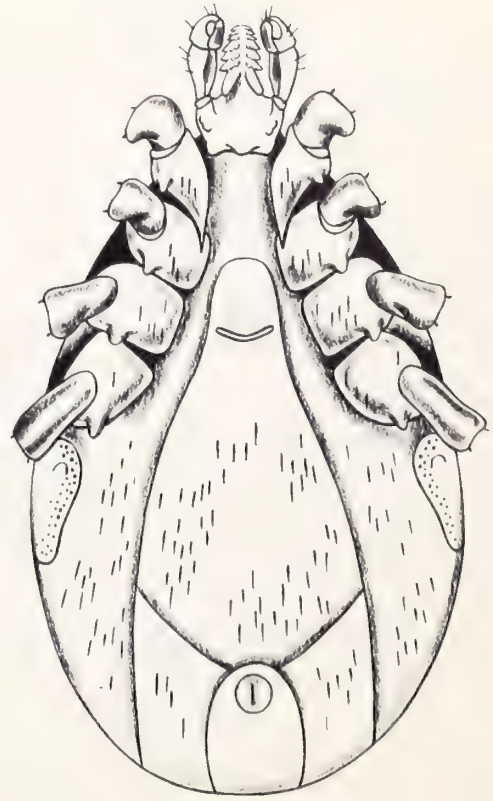
Ixodes scapularis

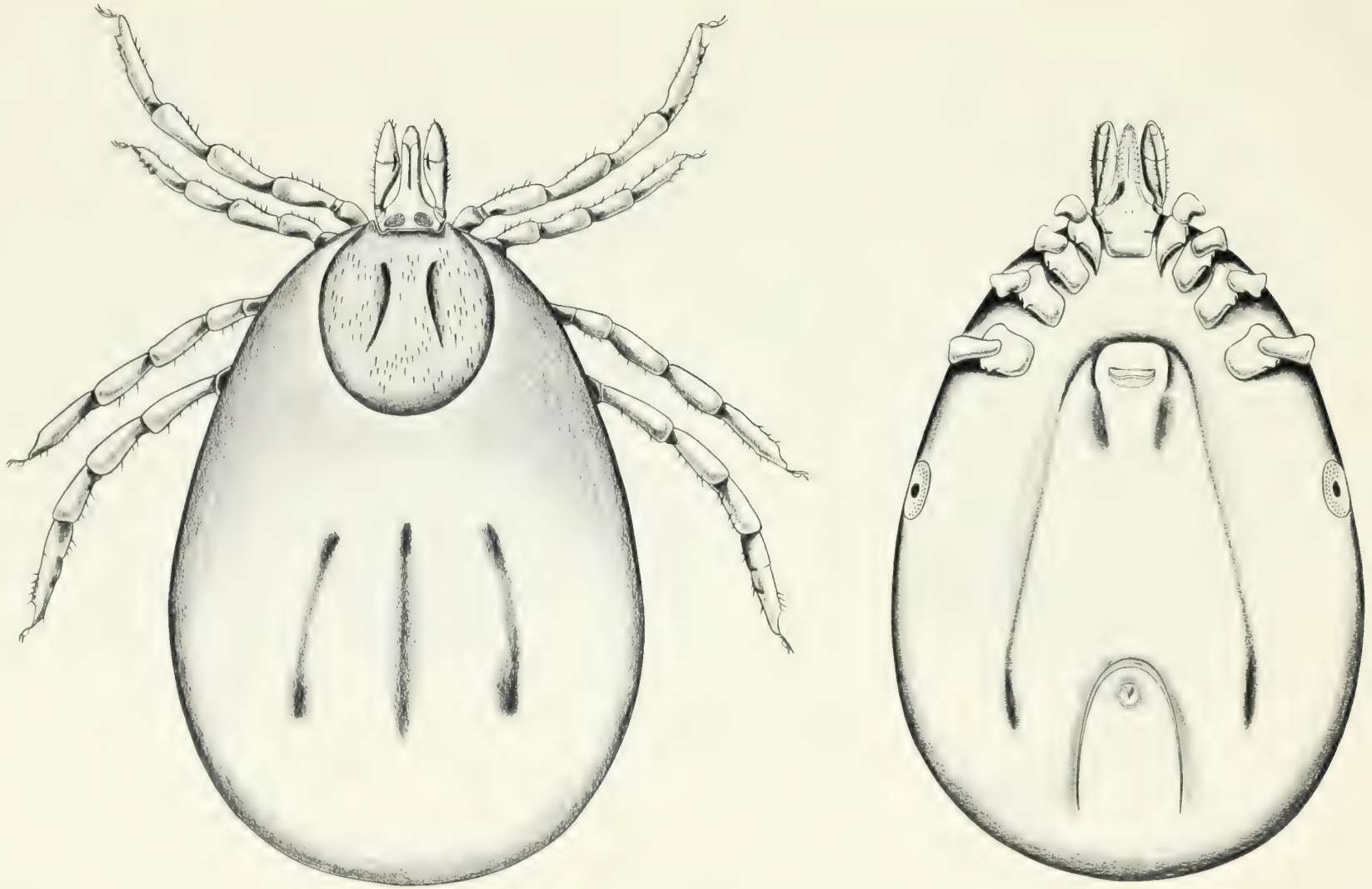
Dorsal

MALE

Ventral







Dorsal

ENGORGED FEMALE

Ventral

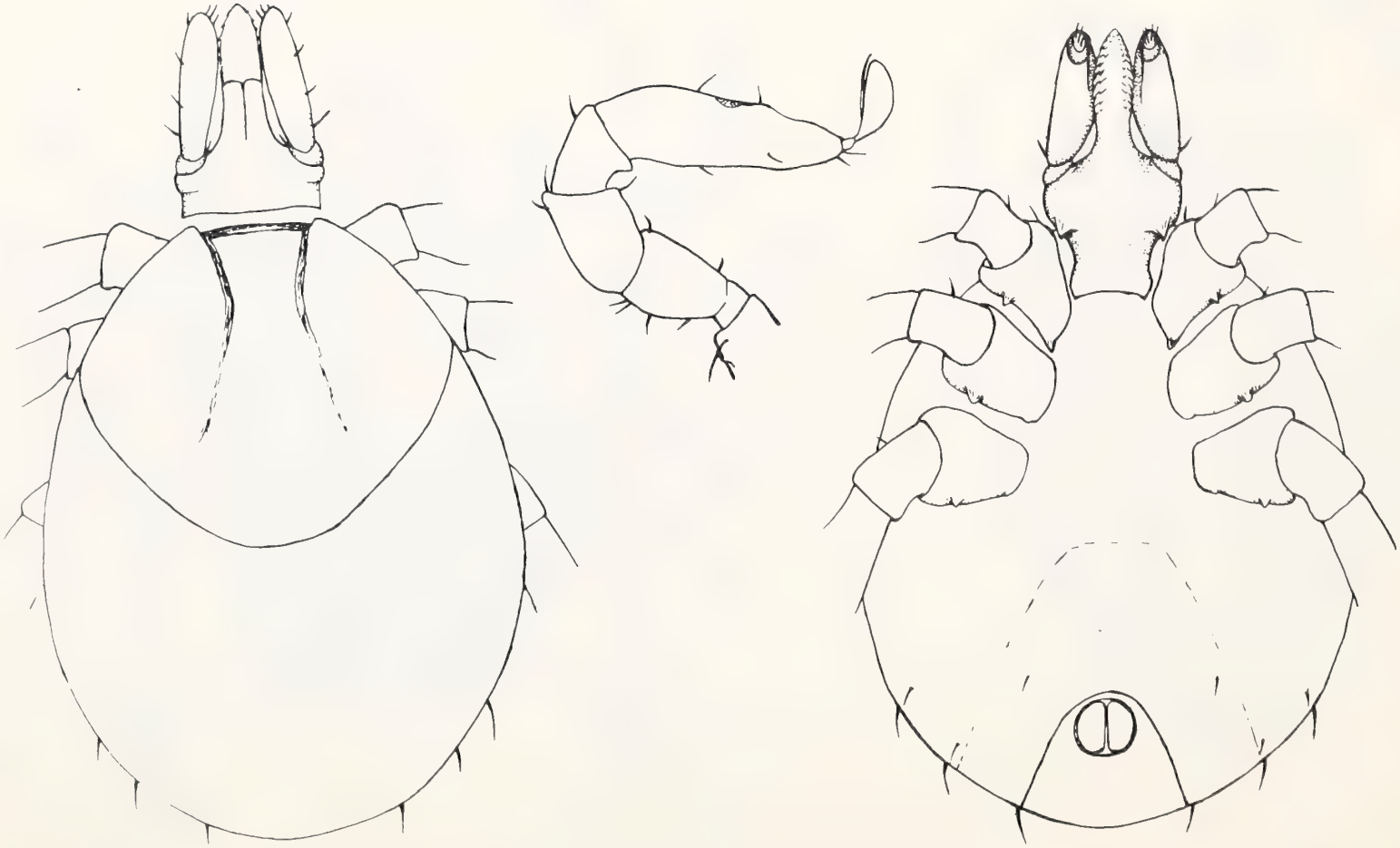
Ixodes scapularis

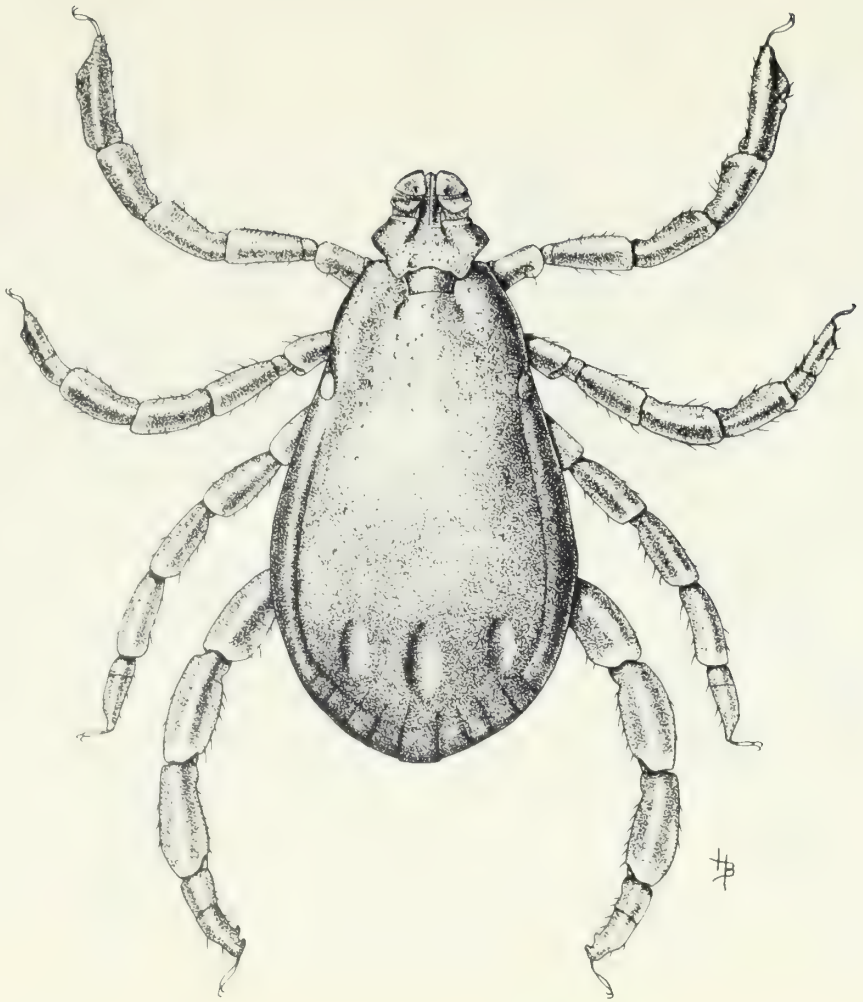
Ixodes scapularis

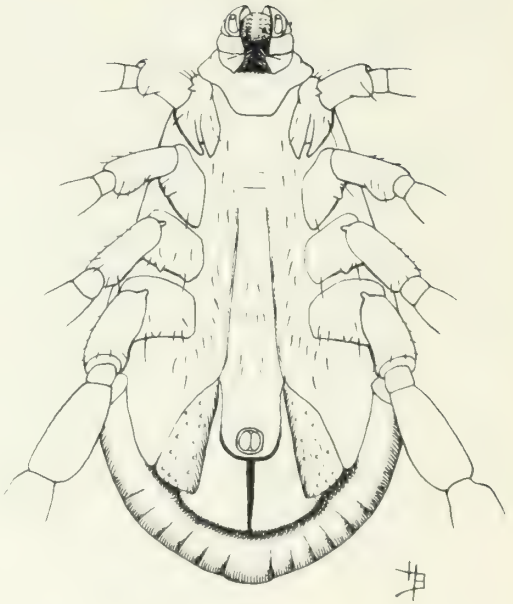
Dorsal

LARVA

Ventral







Dorsal

MALE

Ventral

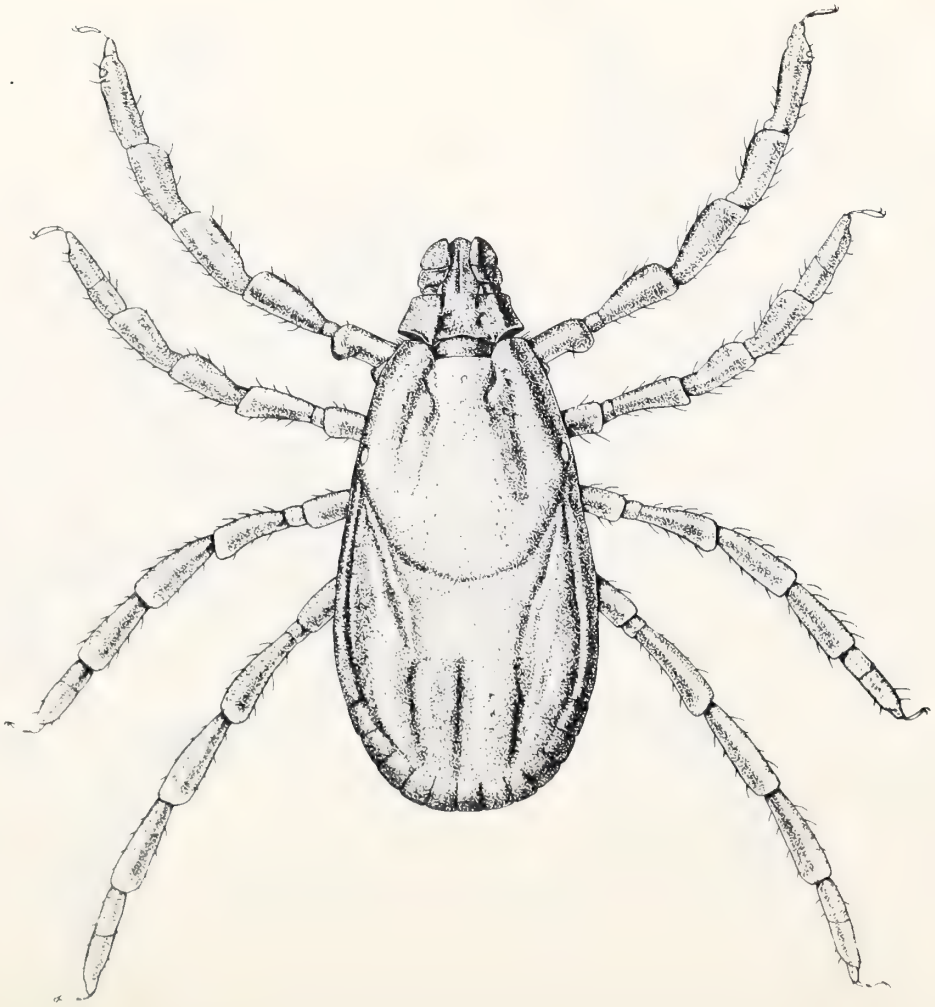
Rhipicephalus sanguineus

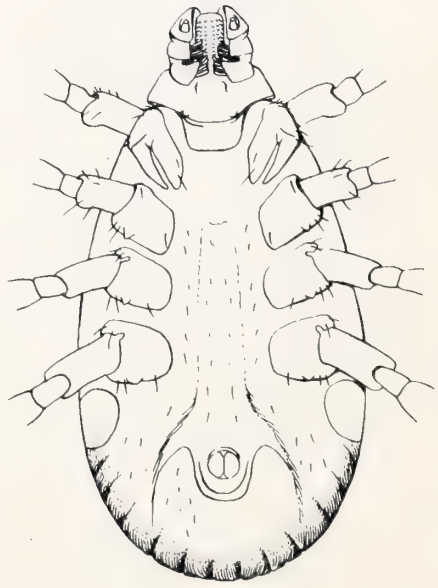
Rhipicephalus sanguineus

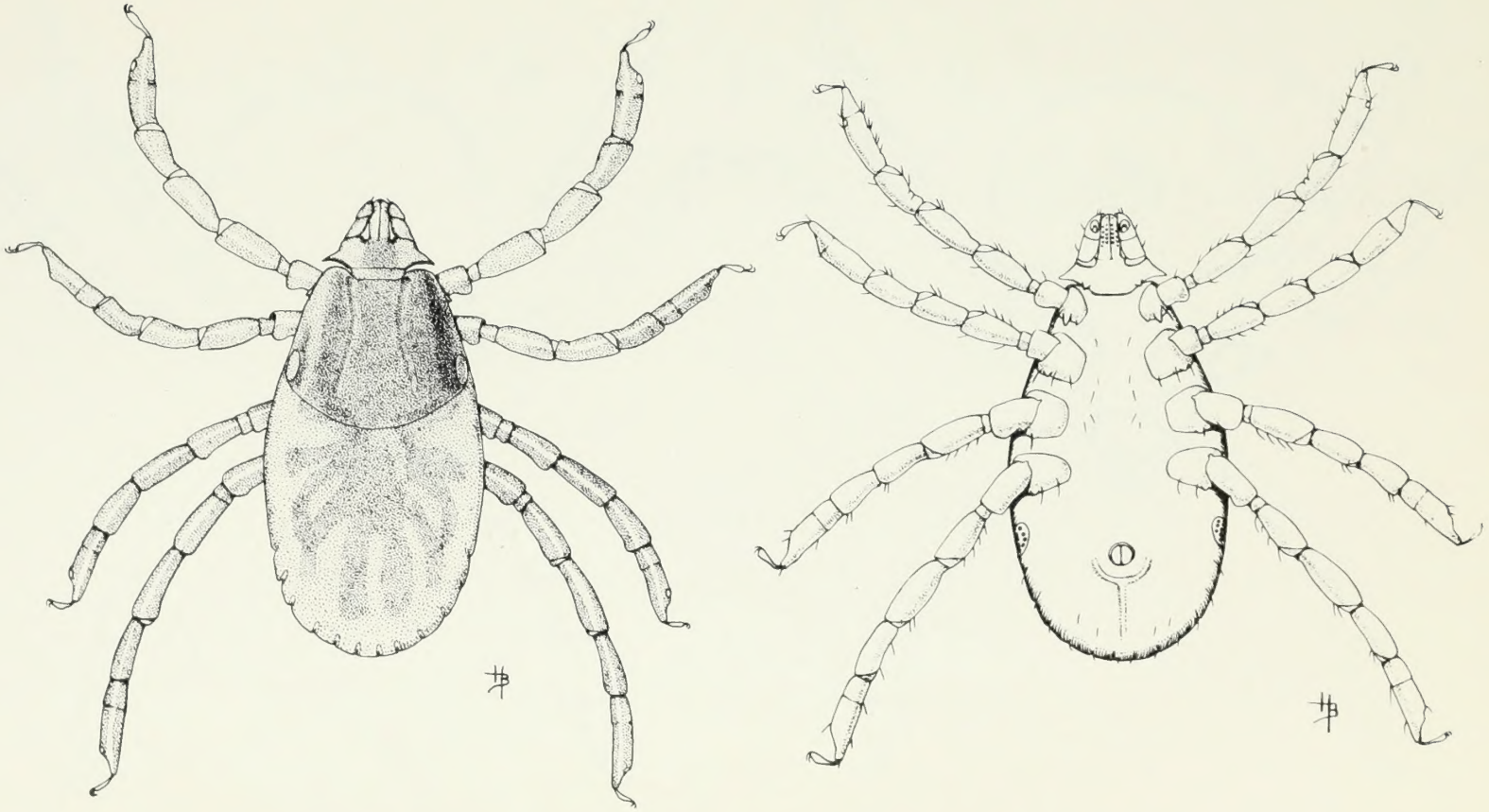
FEMALE

Dorsal

Ventral







Dorsal

NYMPH

Ventral

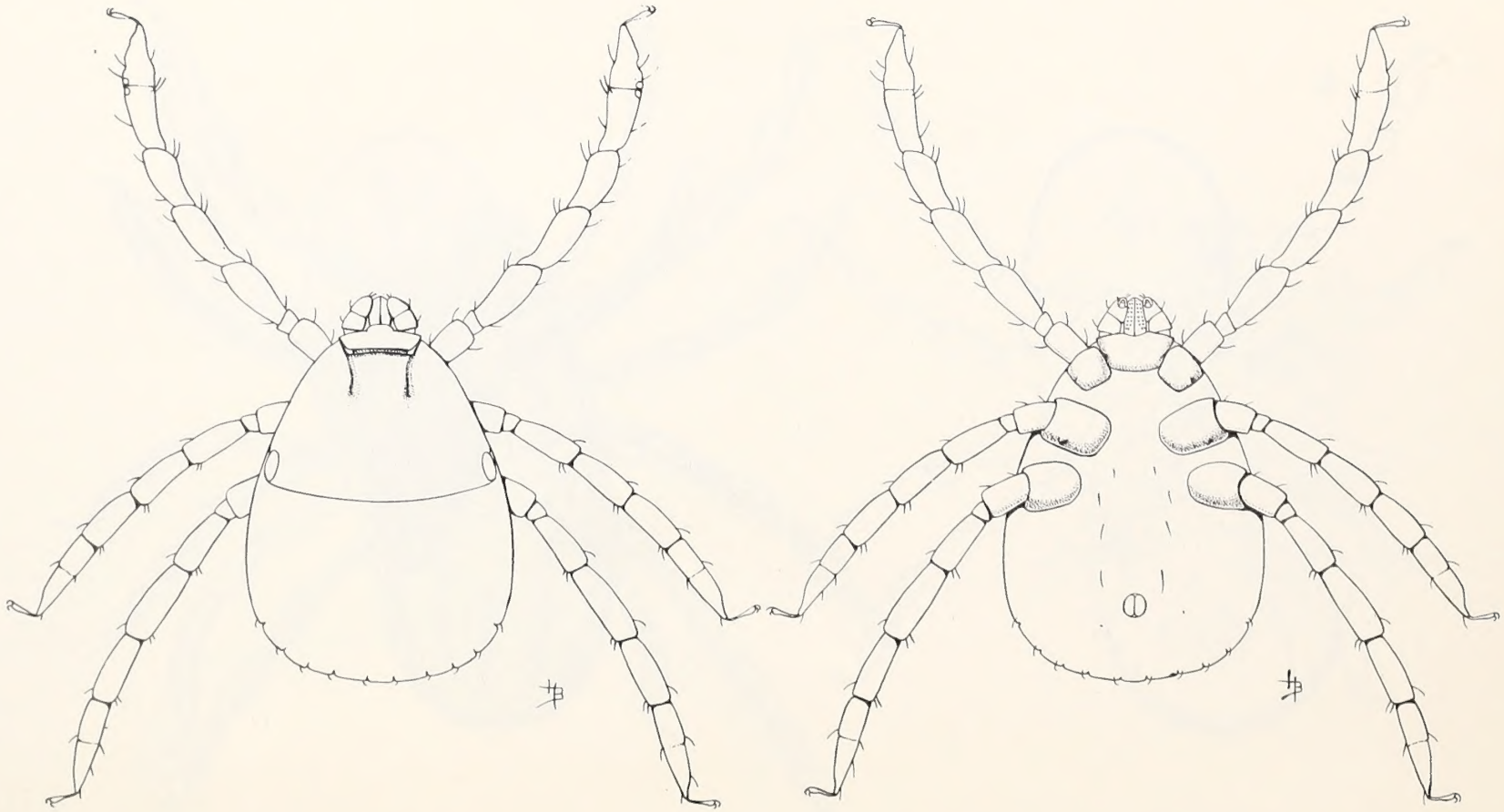
Rhipicephalus sanguineus

Rhipicephalus sanguineus

Dorsal

LARVA

Ventral



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